SCIENCE-IX

MODULE - 3

INDEX

Shrivastava Classes, D-27, Near JVTS Garden,Chattarpur Extension
New Delhi - 110074
9810934436 , 8076575278 , 8700391727

THE FUNDAMENTAL UNIT : CELL

Cell

Cell is the basic structural and functional unit of all living organisms. All living organisms are structurally composed of cells.

Unicellular Organisms

A single cell constitute the whole organism, e.g., Amoeba, Chlanydononas, bacteria.

Multicellular Organisms

Many cells grouped together and assume different functions in the body to form various body parts e.g., plants, animals. Every multicellular organism has come from a single cell which divides to form cells of their own kind.

Prokaryotic Cell

It have no nuclear envelope and membrane bound organelle, e.g., bacteria, cyanobacteria.

Eukaryotic Cell

Nucleus is well defined and have DNA in it, e.g. plant, animal

Plant Cell

Cell well is present, so the cell shape well defined. Comparatively larger, the peripheral, central space is occupied by a large vacuole. Plant cells lack centrosome and centrioler, nucleus lies on one side.

Animal Cell

Generally smaller in size. Do not have cell wall. Prominent and highly complex golgi bodies are present. Animal cells posses centrioles, nucleus lies in the centre.

Structural Organisation of Cell

Plasma Membrane

It is outermost covering of cell that is composed of proteins and lipid. It allows permit the entry and exist of some materials. It maintains the shape of the cell, acts as mechanical barrier and protects the internal contents of the cell. Transport of substances across the membrance takes place by **diffusion** and **osmosis.**

Cell wall

It is found only in plant cell. It is tough, flexible, but fairly rigid outer convering living outside plasma membrane. It permits the cells of plants, fungi and bacteria to withstand much greater changes in surrounding medium than animal cells.

Nucleus

It is popularly called as brain of cells. It controls all functions of a cell. It determines the cell development and maturity by directing the chemical activities of cell. It plays an important role in cellular reproduction in which a cell divide to form

Cytoplasm

It is the fluid content inside the plasma membrane. It also contains many specialised cell organelle. It helps in exchange of material between cell organelles. It is a site of certain metabolic pathways such as glycolysis.

ER

It is large network of membrane bound tubules and sheet. ER membrane is made up of lipid and proteins.

Mitochondria

It is know as power house or cell. It release energy required by cell in form of ATP.

Golgi Apparatus

It consist of a system of membrane bound vesicles called cisternae. It helps in formation of lysosomes and acrosomes.

Lysosomes

They are suicidal bags of a cell. It forms the waste disposal system of a cell.

Plastids

These are found only in plant cell. They are chromoplast, chloroplast and leucoplast.

Vacuoles

These are storage sacs for solid and liquid contents. Tehy are small sized in animal cell and large sized an plant cell.

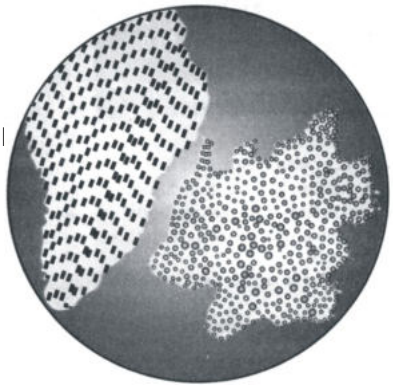
CYTOLOGY

The cell and its structures are studied under a branch of biology called cytology.

Definition :- The structural & functional unit of living beings is called cell.

DISCOVERY OF CELL

1. **Robert Hooke (1665) :–** An English man and first curator of **Royal society of London.**
   Observed a thin transverse section of bark of a tree under sel
   He noticed **honey - comb like compartments.**
   He coined the term cell .
   He wrote a book - **Micrographia.**
   He actually observed dead cells.
2. **Antony Van Leeuwenhoek (1674)** was first to observe living cells like bacteria [from tartar of teeth] erythrocytes [fish], sperms and protozoans [eg. *Vorticella*]



Cork section shown in Robert Hooke's Microscope

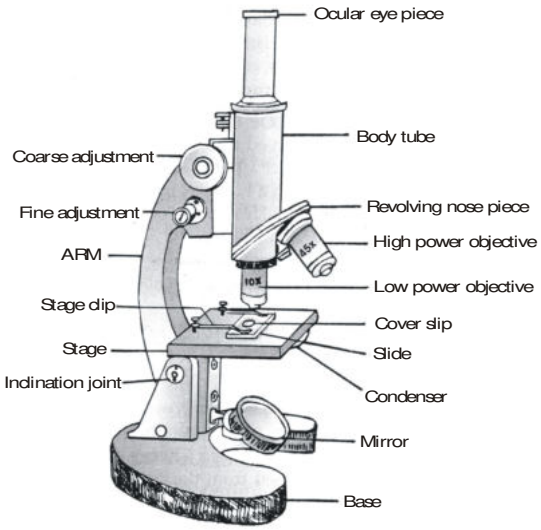
3. **N. Grew (1682) :–** Proposed cell concept which states that **cell is unit of structure of organisms.**
4. **Cell is called structural & functional unit of life because –**
   (i) All the living organisms are composed of one or more cells.
   (ii) All the cells have similar basic structure.
   (iii) Similar cell organelles of different cells perform similar functions.
5. **Knoll and Ruska (1932)** of Germany designed the electron microscope which was employed to study the ultrastructrue (fine structure) of cell and various cell organelles in 1940s.

MICROSCOPE

It is instrument which is used to study those objects that cannot be seen with the naked eye or with the help of a hand lens. A microscope has more than one lens. The 1st compound microscope was built by F. Janssen and Zacharias Janssen (1590).

◈ **Structure of Microscope:** The microscope used in schools is called compound microscope, a compound microscope has following parts:

1. **Base:** It is the basal, metallic, horse-shoe shaped structure. It bears the whole weight of microscope.
2. **Handle:** It is the curved part to hold the microscope. It is also called as arm.
3. **Stage:** It is a strong metallic, rectangular, horizontal plate fixed to the handle.
4. **Stage Clips:** Two clips are attached to stage used for holding the slide in position.
5. **Condenser:** Below the stage is present a condenser for concentrating the light rays.
6. **Body tube:** It is wide, hollow tube attached to the upper part of the arm. To this tube lenses are attached.
7. **Adjustment Screw:**
   (a) Coarse adjustment: It is bigger sized screw used to move the body tube up and down.
   (b) Fine adjustment: It is a smaller sized screw for fine focussing.
8. **Reflecting Mirror:** It is meant for reflecting the light rays, so that light passes through the object which is to be seen.



Parts of an ordinary compound microscope

CELL THEORY

Two biologists, "Schleiden and Schwann' gave the "Cell theory" which was later on expanded by "Rudolf Virchow". Cell theory states that-

(i) All plants and animals are composed of cells.

(ii) Cells is the basic unit of life.

(iii) All cells arise from pre-existing cells.

Ciruses are the exceptions of cell theory.

CELL SIZE & SHAPE

(A) Size of cell – Normal size in human 20 µm to 30 µm in diametre.

(i) Largest cell – In animals – Ostrich egg [15 cm is diametre]

In plants – *Acetabularia* [6-10 cm]

(ii) Longest cell – In animals – Nerve cell [upto 1mt]

In plants – Hemp fibre.

(iii) Smallest cell – PPLO – Pleuro Pneumonia Like Organism [***Mycoplasma*** – 0.1 to 0.5 µm.]

(B) Shape of cell – Shape of cell mainly depends upon the specific function it performs.

(i) Elongated – Nerve cell (ii) Discoidal/saucer – RBC

(iii) Spindal – Muscle cell (iv) Spherical – Eggs.

(v) Branched – Pigment cell of the skin. (vi) Slipper shaped – *Paramecium*

(vii) Cuboidal – Germ cells of gonads. (viii) Polygonal – Liver cells.

TYPES OF CELL

(A) On the basis of type of organization, cells are of two types:

(i) Prokaryotic cells: these are primitive and incomplete cells. they have less developed nucleus without nuclear membrane and nucleolus e.g. Bacteria.

(ii) Eukaryotic cells: these are well developed cells. They have advanced nucleus with nuclear membrane.

(B) On the basis differentiation:

(i) Undifferentiated: These are unspecialized cells which by mitotic divisions give rise to new cells for the formation and maintenance of tissues.

(ii) Differentiated: These are specialized cells formed from the unspecialized cells by change in structure and function during develoment and growth of an organism.

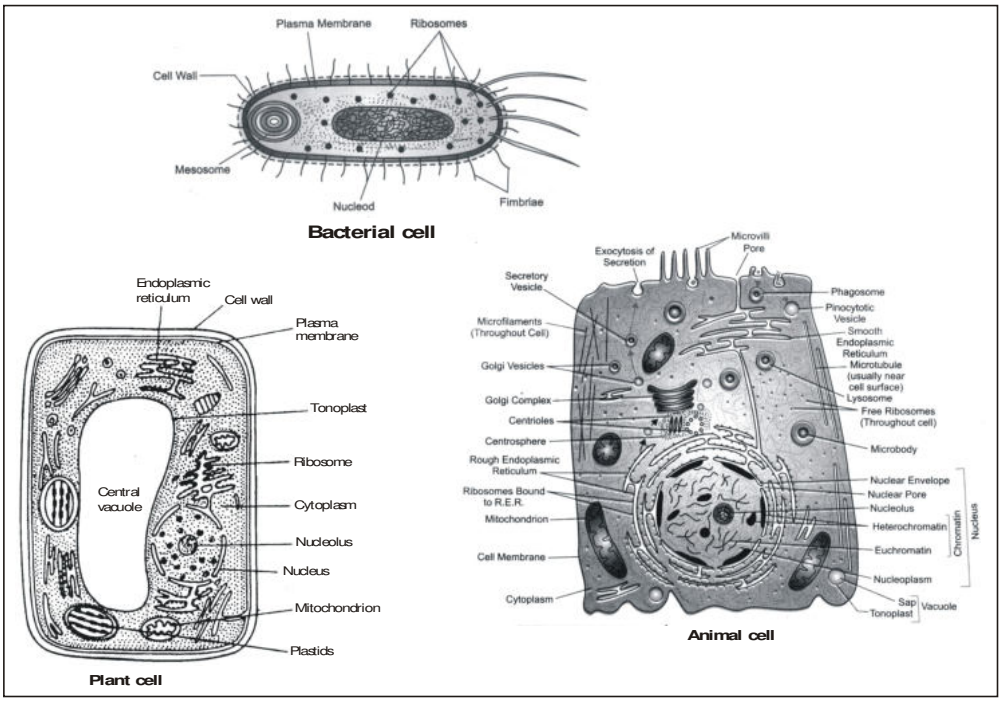
(iii) Dedifferentiated: These are specialized cells reverted to a more generalized (embryonic), actively dividing state. Dedifferentiation often occurs for regeneration.

DIFFERENCES BETWEEN PROKARYOTIC & EUKARYOTIC CELLS

Feature	Prokaryotic cell	Eukaryotic cell
Cell size	Average diameter 0.5-5μm	Diameter varies between. 1μm-40 μm
Protoplasm	Relatively rigid, resistant to desiccation (drying) and can withstand wide changes in pressure and temperature	More fluid and sensitive to drying and to changes in temperature and pressure.
Nucleus	Lacks true nucleus; circular DNA lies naked in the cytoplasm; no chromosomes, nucleolus or nuclear membrane; **nucleoplasm** undifferentiated from cytoplasm	True nucleus bound by nuclear membrane contains linear DNA associated with proteins and RNA (forming chromosomes); nucleolus and nuclear membrane present; nucleoplasm distinct
Organelles	Membrane-bound organelles like Golgi bodies, plastids, mitochondria and endoplasmic reticulum (ER) are absent.	Membrane-bound organelles present.
Ribosomes	Smaller and randomly scattered in the cytoplasm	Bigger, can be free or attached to the ER
Cell division	Divides by simple fission; spindle is not formed; no mitosis and meiosis	Divides by mitosis or by meiosis
Respiration	Respiratory enzymes are located on the plasma membrane	Mitochondria are the seat of aerobic respiration
Photosynthesis	No organized chloroplast; photosynthesis takes place on photosynthetic membranes which lie freely in the cytoplasm.	Organized chloroplasts (containing stacked membranes called grana) take part in photosynthesis
Examples	Bacteria and cyanobacteria (blue-green algae)	All other organisms.

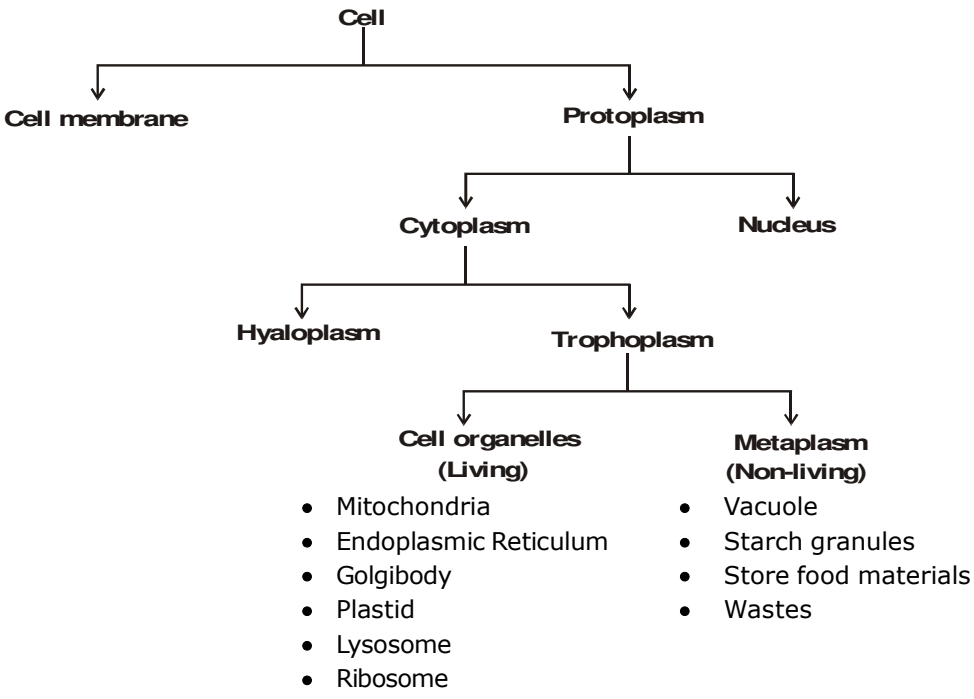
DIFFERENCES BETWEEN PLANT CELL & ANIMAL CELL

	PLANT CELL	ANIMAL CELL
1.	Plant cells are usually larger than animal cells	Animal cells are generally small in size.
2.	The plasma membrane of a plant cell is surrounded by a rigid cell wall made up of cellulose.	Cell wall is absent.
3.	Plastids (leucoplasts, chloroplasts, chromoplasts) are present in plant cells.	Plastids are absent.
4.	Vacuoles are present in abundance. They are larger in size.	Vacuoles are less in number and smaller in size.
5.	Plant cells have many simpler units of Golgi complex, called **dictyosomes**.	Animal cells have a single highly elaborate Golgi complex.
6.	Centrioles have not been found in plant cells (except in a few lower plants.	Animal cells possess centrioles.
7.	Cytokinesis takes place by cell-plate formation.	Cytokinesis takes place by constriction during cell division.
8.	Plant cells usually have a regular shape.	Animal cells are usually irregular in shape.



COMPONENTS OF A CELL

There is an occurrence of division of labour within a cell as they all got certain specific components called "Cell organelles" each of them performs a specific function.
The three basic components of all the cells are
(i) PM (Plasma Membrane) (ii) Nucleus (iii) Cytoplasm



Types of membranes :-

(i) **Impermeable membrane :-** If the membrane does not allow passage of substances (solvent and solute) through it.

(ii) **Permeable membrane :-** If the membrane allows free passage of solute and solvent through it.

(iii) **Semipermeable membrane :-** If the membrane allows passage to solvents but prevents the passing of solutes.

(iv) **Selectively permeable membrane :-** If the membrane allows the passage of solvent and few selected solutes.

Advantage of Semipermeability membrane :- Semipermeability ensures that

1. The useful molecules enter the cell,
2. The metabolic intermediates remain within the cell and
3. The secretions and wastes leave the cell.

Thus, semipermeability of cell membranes enables the cell to maintain homeostasis, i.e., a constant internal environment inspite of the changes outside it.

The substances generally drawn in the cell include :

(i) Raw materials for metabolism, viz. food stuffs, water, salts and oxygen; and

(ii) Regulatory substances, e.g., vitamins and hormones.

The substances generally turned out of the cells include :

(i) The products of metabolism, namely, nitrogenous wastes and carbon dioxide; and

(ii) Secretions.

Following mechanisms are involved in the entry or exit of various materials across p.m.

(A). Physical processes. (B) Biological processes.

A. Physical Processes :- These processes are slow and do not expend energy. These occur down the concentration gradient and do not use carrier proteins. Physical processes include. (i) Diffusion, (ii) Osmosis.

B. Biological processes :- These processes are rapid and often use energy in the form of ATP. These can occur down as well as against the concentration gradient and often use carrier proteins. Biological processes include:-

1. Mediated transport
   (i) Facilitated transport / diffusion (ii) Active transport
2. Endocytosis (Pinocytosis and Phagocytosis)
3. Exocytosis.

1. Diffusion :- The process by which a substance uniformly spreads into another substance by random movement of its particles from a region of higher concentration to a region of its lower concentration due to their kinetic energy is called diffusion.

It is faster in gaseous phase than in liquid phase or solid phase.

Significance of diffusion :-

(i) Diffusion helps in the distribution of various substances throughout the cytoplasm of the cell without much delay.

(ii) It helps in the exchange of respiratory gases (oxygen and carbon dioxide) between the body cells and their environment.

(iii) Various materials such as gases, liquids and solids dissolve in the medium, i.e., air or liquid by diffusion.

(iv) Loss of water in vapours form from the aerial parts of the plants (transpiration) occurs through diffusion.

(v) Flowers of plants spread aroma through diffusion. It attracts insects and other animals for pollination.

CELL MEMBRANE OR PLASMA MEMBRANE

Each cell (prokaryotic as well as eukaryotic) is surrounded by a covering called **plasma membrane** or ***plasmalemma or cell membrane.*** Most cell organelles in eukaryotic cells (e.g., Mitochondria, Plastids, Golgi apparatus, Lysosomes, Endoplasmic reticulum, Peroxisomes, Vacuoles etc). are enclosed by subcellular unit membranes. These membranes, thus, compartmentalise the cell.

Molecular Structure of Plasma membrane.

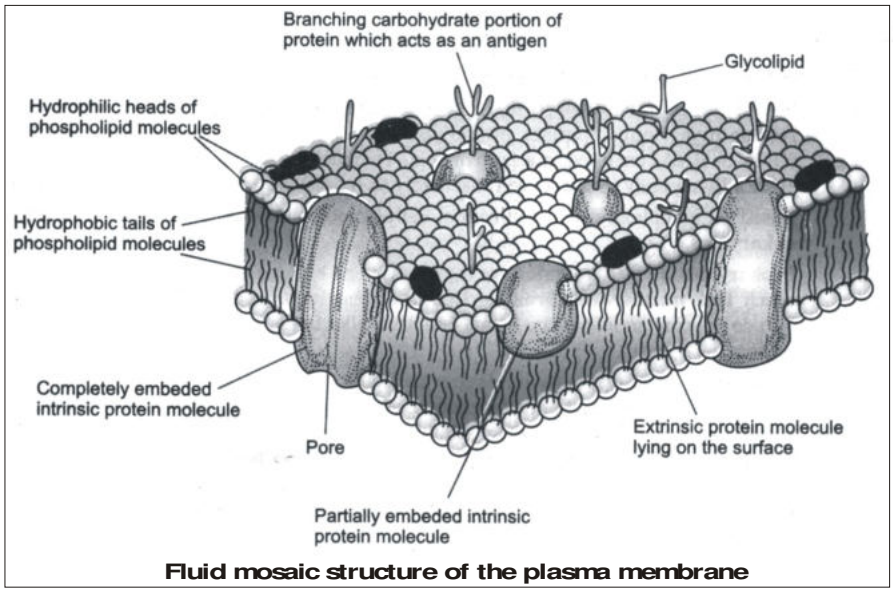
Plasma membrane is a living, ultra-thin, elastic, selectively permeable membrane. Chemically, it is composed of phospholipids, proteins, oligosaccharides and cholesterol.

Trilamilar or 3-layered structure :- J.D. Robertoson noted trilamilar or 3-layered structure for all membranes he studied. Based on his findings, he proposed the **'unit membrane hypothesis' in 1959**.

Fluid Mosaic Model :- In 1972, **S.J. Singer and G. Nicolson** proposed fluid mosaic model **to explain the structure and functions of plasma membrane.** According to this model, the plasma membrane is made up of a **phospholipid bilayer** and two types of **protein molecules** 'floating about' in the fluid phospholipid bilayer. The two types of proteins are (i) **Intrinsic proteins** which are embeded in the phospholipid matrix incompletely or completely, and (ii) **Extrinsic proteins** which occur superficially either on the outer surface or on the inner surface of the phospholipid layer. In other words, the membrane is a viscous fluid with phospholipids and protein molecules arranged as a mosaic.

Oligosaccharide molecules are present on the exposed surface of the plasma membrane. They are associated with proteins as well as lipid molecules forming glycoproteins and glycolipids respectively. **Cholesterol** molecules are inserted between the phospholipid molecules of plasma membrane of animal cells to stabilize the membrane.

Presence of lipids and proteins provides flexibility to the plasma membrane. Proteins present in the membrane serve as :-



Fluid mosaic structure of the plasma membrane

(i) **Enzymes** catalysing chemical reactions within the membrane.

(ii) **Transport proteins** (permeases) for movement of water soluble ions.

(iii) **Pumps** for active transport of materials and

(iv) **Receptor proteins** (e.g., glycoproteins on the cell surface) to recognize and bind specific molecules such as hormones.

Fluid mosaic model is also described as "a number of protein icebergs floating in the sea of lipids'.

Osmosis :-

The diffusion of water or solvent through a semipermeable membrane from a solution of lower concentration of solutes to a solution of higher concentration of solutes to which the membrane is relatively impermeable, is called osmosis.

Osmosis is of two types :

1. **Endomosis**
2. **Exomosis**

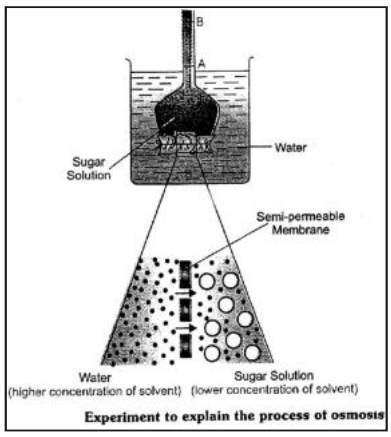
Endosmosis : It is the entry of water molecules into the cells through semipermeable plasma membrane when surrounded by hypotonic solution.

Exosmosis : It is the exit of water molecules from the cells through semipermeable plasma membrane when surrounded by hypertonic solution.

Experiment : Demonstration of osmosis in the laboratory.

Requirements : Funnel fitted with a semipermeable membrane, beaker, sugar solution, water.

Procedure : Take sugar solution in a funnel fitted with a semipermeable membrane (fish bladder or egg membrane) upto mark 'A' and place it in an inverted position in a beaker filled with clean water as shown in figure. After some time, observe the level of sugar solution in the funnel.



Experiment to explain the process of osmosis

Result :- You would find that the sugar solution has risen from level 'A' to a new level 'B'.

Explanation and conclusion : Sugar solution in the funnel and water in the beaker are separated by a semipermeable membrane. The fitted membrane is permeable to small water molecules but is relatively impermeable to large sugar molecules dissolved in water.

Due to difference in the concentration of solute on the two sides of semipermeable membrane, water molecules have moved from the solution having lower concentration of solutes (e.g., water in this experiment) to the solution having higher concentration of solutes [e.g. sugar solution] due to osmosis has risen to new level 'B'.

Types of solutions :

1. **Isotonic solution**
2. **Hypotonic solution, and**
3. **Hypertonic solution.**

1. Isotonic solution :-

Isotonic solution is one in which the concentration of water and solutes is the same as in the cytoplasm of the red blood cells. 0.9% salt solution and 5% glucose solution are isotonic for red blood cells.

2. Hypotonic solution :-

Hypotonic solution is one in which the concentration of solutes is less and concentration of water is more as compared to inside the red blood cells. 0.66% salt solution and 0.2% glucose solution are hypotonic for red blood cells.

3. Hypertonic solution :-

Hypertonic solution is one in which the concentration of solutes is more and the concentration of water is less as compared to in the cytoplasm of the red blood cell. 1.25% salt solution and 10% glucose solution are hypertonic for red blood cells.

Other examples of osmosis :-

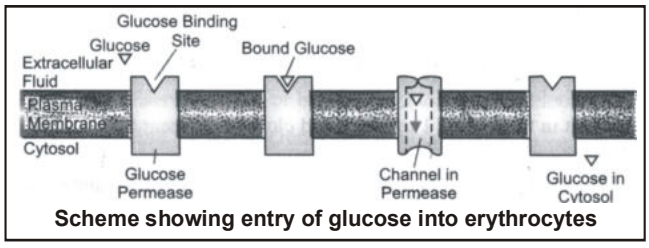
1. Fresh water unicellular organisms (e.g., ***Amoeba, Paramecium***) continuously gain water in their bodies due to osmosis. These organisms have mechanisms (e.g., contractile vacuoles) to throw out excess of water from their bodies.
2. Most plant cells have the tendency to gain water due to osmosis.
3. Absorption of water by the plant roots from the soil through root hairs is also an example of osmosis.
4. Certain plant movements (e.g., seismonastic movements in 'touch-me-not' plant) occur due to loss or gain of water.
5. Stomata are present in the leaves. They open and close at different times of the day due to osmotic movements of water.
6. In plants, cells, tissues and soft organs (leaves, young shoots, flowers) maintain turgidity or stretched form due to osmotic absorption of water.

DIFFERENCES BETWEEN DIFFUSION AND OSMOSIS

S.No.	Diffusion	S.No.	Osmosis
1	Diffusion can occur both in air and liquid (water) medium	1	Osmosis occurs only in liquid medium
2	It involves movement of molecules (Solids, liquids or gases) from the region of their higher concentration to the region of their lower concentration.	2	It involves movement of solvent molecules only from the region of their higher concentration to the region of their lower concentration.
3	It can occur without or through a semipermeable membrane.	3	It always takes place through a semipermeable membrane.
4	It equalizes the concentration of diffusable molecules throughout the medium.	4	It does not equalize the concentration of solvent molecules in the medium involved.
5	It is dependent upon the kinetic energy of the molecules of diffusing substance only.	5	Though it is the diffusion of solvent molecules only, yet it is influenced by the presence of solutes in the system.

Mediated transport :

Type of transport of materials across the plasma membrane with the help of carrier proteins is called mediated transport.



Scheme showing entry of glucose into erythrocytes

Types of mediated transport

Mediated transport is of following two types :

(i) Facilitated transport

(ii) Active transport

(i) Facilitated transport :- In this case, transport proteins (e.g. permeases) assist molecules to diffuse through the membrane down the concentration gradient, i.e., from the region of higher concentration to the region of lower concentration across the membrane. It is, therefore, also termed as **facilitated diffusion.** No cellular energy is used in such transport. A carrier protein combines with a specific substance (e.g., glucose) to be transported and moves it down the concentration gradient from one side of membrane to another through a channel formed by it.

In liver and red blood cells, facilitated transport moves glucose across the cell membrane by specific carrier protein molecule in both directions, depending upon whether glucose concentration is higher inside or outside the membrane.

(ii) Active transport :- In this case, carrier proteins move substances against the concentration gradient, i.e., from lower concentration to higher concentration. This "uphill" transport involves work and always requires energy provided by ATP (adenosine triphosphate).

Mechanism of active transport of materials is described below :

(i) The carrier protein has a binding site for ATP in addition to the binding site for the substrate. As the ATP molecule binds to the carrier protein, it is hydrolyzed to ADP.

(ii) The energy so set free brings the substrate binding site of the carrier protein to the surface of the membrane. The substrate present in the medium joins the carrier protein at substrate binding site to form carrier-substrate complex.

(iii) The substrate bond carrier protein undergoes conformational change and carries the substrate through a channel in it to the cytoplasmic side of the membrane.

(iv) Now, the form of binding site changes and the substrate is released. The carrier protein regains its original form and is ready to transport another molecule of substrate.

There are many active transport systems in the cell. Among these, **sodium-potassium exchange pump** is prominent. It maintains sodium and potassium gradients between cells and the surrounding extracellular fluid.

Importance of active transport :- The $Na^+ - K^+$ exchange pump plays following roles :

(i) It helps in maintaining a positive charge on the outside of the membrane and negative charge on the inside (resting potential),

(ii) It helps in nerve impulse conduction,

(iii) It helps in muscle contraction,

(iv) It helps in urine formation in kidney tubules,

(v) It helps in salt excretion in marine birds, and

(vi) It helps in controlling water contents of the cell.

DIFFERENCES BETWEEN ACTIVE TRANSPORT AND DIFFUSION			
S. No.	Active Transport	S. No	Diffusion
1	It is a rapid process.	1	It is a slow process.
2	It can move materials through a biomembrane against the concentration gradient.	2	It can move materials across a biomembrane down the concentration gradient.
3	It takes place in one direction only.	3	It takes place in both directions.
4	It needs carrier proteins to occur.	4	It occurs without carrier proteins.
5	It uses energy of ATP.	5	It does not use energy.
6	It brings about selective uptake of materials.	6	It allows all transmissible molecules to pass through membranes
7	It leads to accumulation of materials in the cells.	7	It does not accumulate materials in the cells.

Bulk Transport :-

Animal cells can also actively take in and turn out materials in masses much larger than in the hither to described processes by utilizing energy. Such materials include macromolecules, lipid droplets and solid particles. Items of this size cannot cross the phospholipid bilayer by diffusion or with the help of transport proteins. Special processes are involved in the transport of such large quantities of materials.

These include endocytosis (phagocytosis) and exocytosis.

Endocytosis :-

The term endocytosis refers to invagination of a small region of plasma membrane, and ultimately forming an intracellular membrane-bound vesicle. Endocytosis is not shown by plant cells because of their rigid cell wall and internal turgor pressure. Depending upon the intake of fluid droplet or solid particles, endocytosis is of two types :

(i) Pinocytosis **(ii) Phagocytosis**

(i) Pinocytosis :- The non-specific intake of a tiny droplet of extracellular fluid by a cell through the cell membrane which cannot otherwise pass through it. It is also, therefore, termed as **cell drinking**. It was first observed in *Amoeba*. In this process, a small region of plasma membrane invaginates and the fluid droplet passes into the pocket so formed. This pocket is called **caveola**. The pocket deepens and finally nips off as a fluid-filled vacuole called **pinosome or pinocytotic vesicle.**

(ii) Phagocytosis :- Phagocytosis is the intake of solid particles by a cell through cell membrane. It is also called cell eating. Phagocytosis is the major feeding method in many unicellular organisms (e.g., *Amoeba*) and simple metazoa (e.g., sponges).

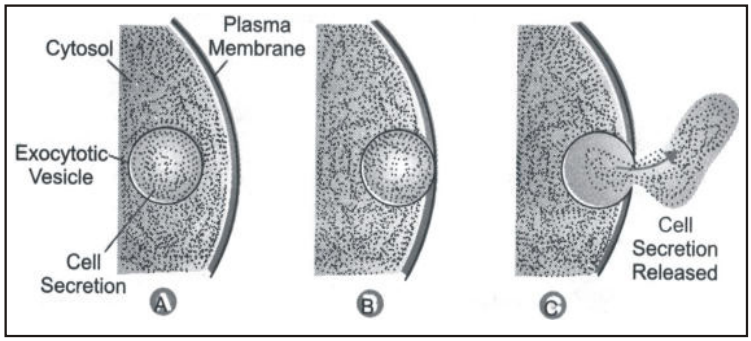
An area of the plasma membrane, coated initially with actin-myosin, comes in contact with the food particle(s). The contact induces the cell membrane to put out tiny protoplasmic processes, the **pseudopodia,** around the food particle(s). The pseudopodia meet on the other side of the food particle(s) and fuse. In this way, an internal vacuole, called **phagosome,** containing food particle(s) in a droplet of water is acquired.

INTERNAL STRUCTURE OF A MITROCHONDRION

DIFFERENCES BETWEEN PINOCYTOSIS AND PHAGOCYTOSIS			
S. No.	**Pinocytosis**	**S. No**	**Phagocytosis**
1	It is the intake of extracellular fluid droplets.	1	It is the intake of extracellular particles
2	Cell membrane invaginates to take up the material.	2	Cell membrane grows around the particle as pseudopodia.
3	Microfilaments play no role in endocytosis.	3	Microfilaments play an important role in phagocytosis.
4	It is a nutritive process.	4	It is a nutritive and defensive process.
5	Pinocytotic vesicles are only 0.1 µm wide.	5	Phagocytotic vesicles are 1 to 2 µm or more wide.

Exocytosis :-

Exocytosis is the process that involves fusion of membrane of the exocytotic vesicle with the plasma membrane to extrude its contents to the surrounding medium.



This process is also called **cellular vomiting** or **ephagy** and the vesicles that turn out the materials are termed **exocytotic vesicles.**

Exocytosis process is responsile for :

(i) removal of undigested food left in the food vacuoles in the cells.

(ii) secretion of substances such as hormones, enzymes, and

(iii) replacement of internalized membrane by the fusion of exocytotic vesicles with the cell membrane.

Functions of plasma membrane

1. It gives a definite shape to the cell.
2. It provides protection to the internal contents of the cell.
3. It regulates entry and exit of substances in and out of the cell.
4. It can internalize solid and liquid materials by infolding or extending around them. This is a process of active intake of materials.
5. In animal cells, it is involved in adhesion, recognition and in the formation of vesicles, cilia, flagella, microvilli, etc.

- Plasma membrane acts as a mechanical barrier to protoplasm so after rupturing or breakdown of plasma membrane, the protoplasmic contents will be dispersed in the surrounding medium.

CELL WALL

Discovered by **Robert Hooke**

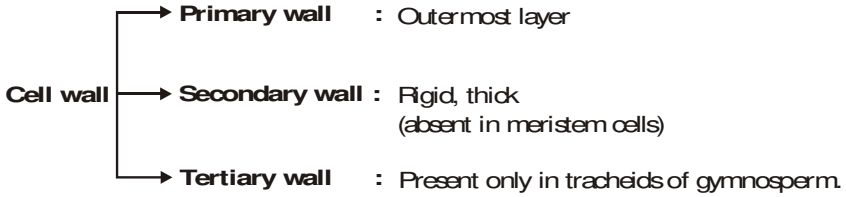
(i) The outermost covering of the plant cell is called *cell wall*.

(ii) It is absent in animal cell.

(iii) It is rigid, thick, porous and non-living structure. It become impermeable due to deposition of cell wall materials.

Middle lamella : Common layer between two plant cells is called middle lamella. It consists Ca & Mg pectates (Plant cement). Fruits becomes soft and juicy due to dissolve of middle lamella.

(i)



(ii) Cellulose is a main constituent of cell wall but addition to cellulose – Hemicellulose, cutin, pectin, Lignin, Suberin are also presents in cell wall

(iii) Cellulose microfibrils and macrofibrils arranged in layers to form skeleton of cell wall. In between these layers other substances like pectin, hemicellulose may be present. These form matrix of cell wall.

(iv) Network of cellulose fibre forms skeleton of cell wall.

35-100 cellulose chain = 1 micelle.

20 micelle = 1 Microfibril

250 micro fibril = 1 macrofibril in cell wall.

(v) **Composition:–**
- (i) Cellulose + Hemicellulose-**in plants**
- (ii) Chitin – **in fungi**
- (iii) Peptidoglycan – **in bacteria and mycoplasma.**

Functions of cell wall :–

1. It determines the shape of the plant cell.
2. It prevents desiccation of cell. [desiccation means drying up of cells]
3. It protects the plasma membrane and internal structures of the cell.
4. It helps in the transport of various substances in and out of the cell.
5. It does not allow too much of water to come in. In this way it prevents the cytoplasm from becoming too dilute.

CYTOPLASM

- Cytoplasm was discovered by Kolliker in 1862.
- It is the site of both biosynthetic and catabolic pathways.
- It can be divided into two parts:

(i) Cytosol: Aqueous soluble part contains various fibrous proteins forming cytoskeleton.

(ii) Cytoplasmic Inclusion: In the cell cytoplasm, there are present numerous living and non-living structures, collectively called cytoplasmic inclusions.

(iii) Cytoplasmic Inclusion: In the cell cytoplasm, there are present numerous living and non-living structures, collectively called cytoplsmic inclusions.

(a) The living cytoplasmic inclusions are called cell organelles or protoplasmic inclusions or organolds and

(b) the non-living structures are called Deutoplasmic or ergastic bodies.

- **Role of Cytoplasm:**

(i) Participates in intracellular distribution of nutrients, metabolites and enzymes.

(ii) Helps in exchange of materials between cell organelle.

(iii) acts as a site of chemical reactions like glycolysis (step of respiration), synthesis of fatty acids.

CELL ORGANELLES

- These are living sub-cellular structures of the cytoplasm and are also called protoplasmic bodies or organoids. These include-
- **Single membranous:** Endoplasmic reticulum, Golgi apparatus, Lysosomes, peroxisomes, Glyoxysomes etc.
- **Double membranous:** Plastid and Mitochondria.
- **Non-membranous:** Ribosomes etc.

NUCLEUS

Introduction :

(i) The nucleus is the most important component of the cell and controls all functional activities of the cell.

Historical Account :

(i) **Robert Brown** (1831) discovered a dense, spherical body in the cells of an 'orchid' and named it as 'Nucleus'.

Ultrastructure :

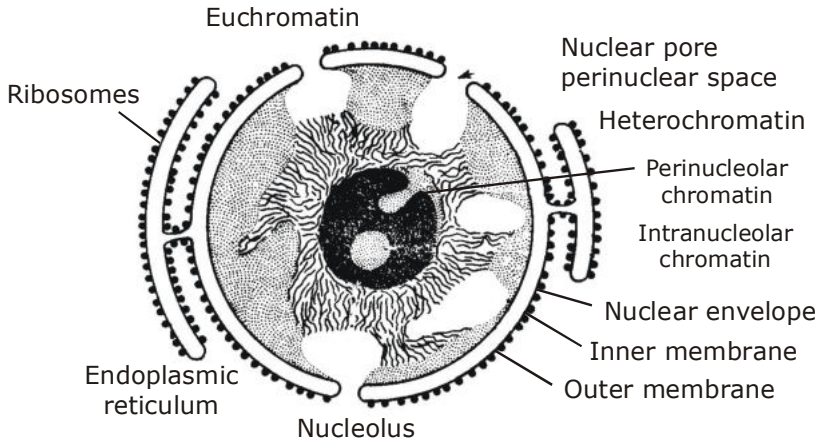
- Nuclear membrane/Nuclear envelope/Karyotheca
- Nuclear sap/ Nucleoplasm/karyolymph.
- Nucleolus.
- Chromatin threads.

(a) Nuclear envelope : Nucleus is surrounded by two membranes, that separates nucleoplasm from cytoplasm. The nuclear membrane has minute pores. These are called nucleo-pores.

(b) Nucleoplasm : The part of protoplasm which is enclosed by nuclear membrane is called nucleoplasm. It contains chromatin threads and nucleolus.

(c) Nucleolus : Discovered by Fontaina. Usually one nucleolus is present in each nucleus but sometimes more than one nucleoli are present. It is a store house of RNA.

(d) Chromation threads : A darkly stained network of long and fine threads called chromatin threads. Chromatin threads are intermingled with one another forming a network called chromation reticulum. Whenever the cell is about to divide the chromatin material gets organized into chromosomes.



ELECTRON MICROSCOPICS
STRUCTURE OF NUCLEUS

❑ **Functions of Nucleus :**

(i) The nucleus control all metabolic activities of the cell.
(ii) It regulates the cell cycle.
(iii) It brings about growth of the cell by directing the synthesis of structural proteins.
(iv) It takes part in the formation of ribosomes.
(v) It contains genetic information and is concerned with the transmission of hereditary traits from one generation to another.

Do you know?

- Chromatin threads are made up of –
  (i) DNA **(ii)** Protein [Histone protein]
- **Gene:–** The segment of DNA and act as unit of heredity
- **ATP:–** Adenosine triphosphate. It is also known as energy currency. It provides energy to perform bio-synthesis & mechanical work.
- **Homologous chromosomes:–** All chromosomes are found in pair and the chromosomes of a pair are called homologous chromosomes.
- **Non-homologous chromosomes:–** Chromosomes of different pair.
- The nucleus of prokaryotes is also known **nucleoid.**
- Nucleus is also called **director of cell** as it controls most of the cellular activities.
- Nucleus is absent in **sieve tubes of vascular plants & mature RBC's of mammals.** Mammalian RBC also lacks Golgibodies, mitochondria, ER, lysosomes.

ENDOPLASMIC RETICULUM

Introduction :

(i) In the cytoplasm some closed or open, branched cavities are present which are bounded by membranes to form a network of membranous system called **Endoplasmic Reticulum.**

Historical Account :

(i) **K.R.Porter** (1948) reported this net-like system under electron microscope.

Ultrastructrure :

(i) A system of membranes attached to the nucleus and present in the cytoplasm is called E.R.
(ii) The Endoplasmic Reticulum (ER) is divided into two parts

✧ It is the netowork of membranes present in the cytoplasm.

- ✧ It was discovered by Porter, Claude and Fullan.
- ✧ These are present in all cells except prokaryotes and mammalian erythrocytes.
- ✧ They are made up of three components:

(A) Cisternate:

- These are long, flattened, parallely arranged, unbranched tubules.
- These form successive layers of nucleus.
- These are found in cells which are active in protein synthesis and are 40 - 50 μm in diameter.

(B) Vesicles: These are rounded or spherical, They are found in synthetically active cells.

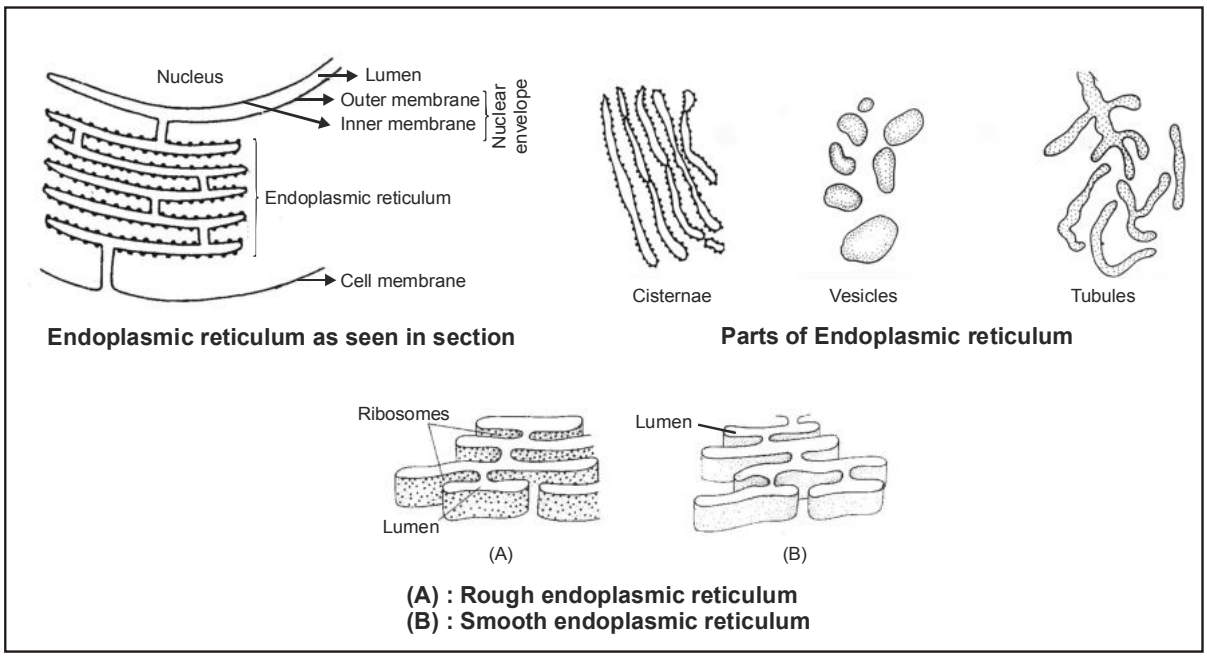
(C) Tubules: These are small, smooth walled and have tubular spaces. These are found in non secretory as well as steroid synthesizing cells.

(a) Rough Endoplasmic Reticulum (RER)

(b) Smooth Endoplasmic Reticulum (SER)

(i) RER possesses rough wall because ribosomes remain attached on the surface. **RER** is present in cells which are involved in protein synthesis.

(ii) **SER** mainly present in cells which are involved in lipoproteins and glycogen synthesis. It perfoms **detoxification**.



❑ **Functions of Endoplasmic Reticulum :**

(i) It forms supporting skeleton framework of the cell.

(ii) Certains enzymes present in smooth E.R. synthesis fats (lipids), steroids and cholesterol.

(iii) Rough E.R. is concerned with protein synthesis.

(iv) Smooth E.R. is involved in the process of detoxification.

PLASTID

- ✧ Plants and some protists have several types of double membrane bound organelles called plastids, which harvest solar energy, manufacture nutrient molecules and store materials.
- ✧ Plastid term was coined by E. Haeckel.

✧ Plastids generally contian pigments and may synthesize & accumulate various substances.

✧ Depending upon the type of pigment present in them they are of following three types.

S.NO.	LEUCOPLAST	CHROMOPLAST	CHLOROPLAST
1	Non Pigmented White in colour	Coloured pigments All colours except green Phaeoplast - Brown Rhodoplast - Red	Green pigment chlorophyll is found in them.
2	Generally found in underground parts Important for food storage. E.g. Aleuroplast (Protein), Elaioplast (Oil), Amyloplast (Starch)	Found in flowers, Fruits, Leaves etc.	Found in aerial parts of plant which are green in colour

✧ **Chloroplast:**

- It is a double membranous discoidal structure, found only in plant cells.
- Chloroplast was discovered by A.V. Leeuwenhoek and named by Schimper.
- Besides being discoidal or rhombic in plant cells they occur in variable shapes like in algae they can be 'U' shaped, spiral, coiled, ribbon shaped etc.
- In each thylakoid Quantasomes are present which are called as Photosynthetic units.
- Each quantasome possesses 230 chlorophyll molecules.
- Each chloroplast consists of two parts.

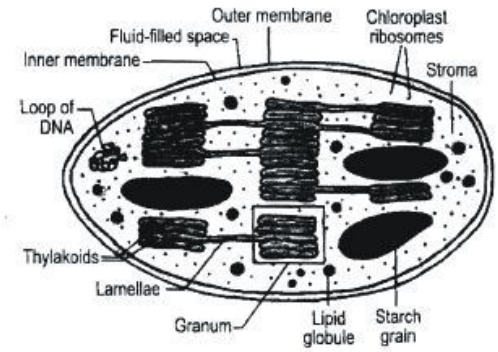
(i) Grana: It constitutes the lamellar system. These are found layered on top of each other, these stacks are called as Grana.

- Each granum of the chloroplast is formed by superimposed closed compartments called Thylakoids.
- **Functions:** Grana are the sites of light reaction of photosynthesis as they contain phtosynthetic pigment chlorophyll.

(ii) Stroma: It is a granular transparent substance also called as matrix.

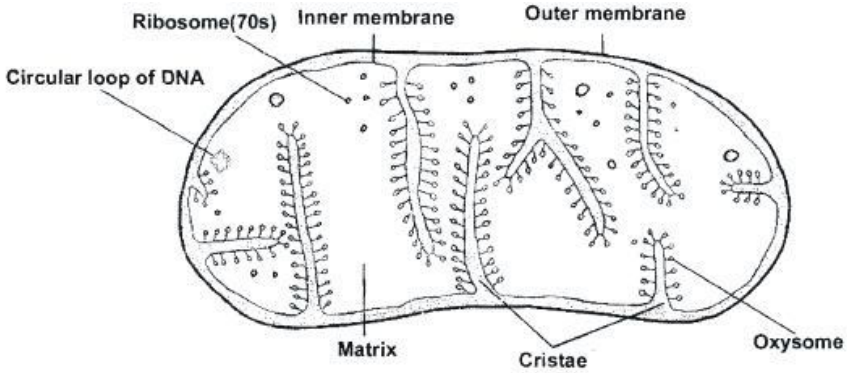
✧ Grana are embedded in it. Besides grana they also contain lipid droplets, starch grains, ribosomes etc.

✧ **Function:** This is the site of drak reaction of photosynthesis.



INTERNAL STRUCTURE OF CHLOROPLAST

MITOCHONDRIA



MITOCHONDRIA

- It was first seen by Kolliker in insect cells and named by Benda.
- It is a rod shaped structure found in cytoplasm of all eukaryotic cell except mammalian RBC's.
- These are also absent in prokaryotes.
- Maximum mitochondria are found in metabolically active cells.
- It is also called as "Power House of the Cell" or the "Storage Battery".
- It is double membranous structure where outer membrane has specific proteins while inner me:nbrane is folded inside to form chambers called Cnstae."Cristae" are the infoldings of inner mitochondrial membrane that possess enzymes for respiratory cycles like Kreb Cycle. ATP synthesizing units are called Oxysomes or F_0 – F_1 Particles.
- Space between inner and outer mitochondrial membranes is called as perimitochondrial space. The fluid present in mitochondria is called as matrix.

(a) Functions:

(i) Its main function is to produce and store the energy in the form of ATP.

(ii) It is the site of Kreb's cycle of respiration, as it contains enzymes for Kreb cycle.

(iii) Oxysome contains enzymes for ATP production.

GOLGI COMPLEX

Discovered by **Camillo Golgi (1898)** in nerve cells of owl.

Other names:–

(i) Lipochondrion, (ii) Idiosome,

(iii) Baker's body, - In fungus (iv) Dalton complex

(v) Dictyosomes – In plants

Position:– It is located near the nucleus.

- The cytoplasm surrounding Golgi body have fewer or no other organelles. It is called **Golgi ground substance or zone of exclusion.**
- Golgi bodies are **pleomorphic structures**, becaue component of golgi body are differ in structure & shape in different cells.

Structure:– It is formed of four types of contents.

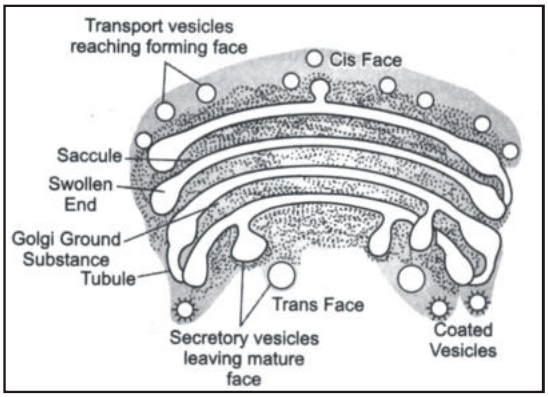
(i) Cisternae – These are long flattened and unbranched saccules. 4 to 8 saccules are arranged in a stack.

(ii) Tubules – These are branched and irregular tube like structures associated with cisternae.

(iii) Vacuoles – Large spherical structures associated to tubules.

(iv) Vesicles – Spherial structures arise by budding from tubules. Vesicles are filled with secretory materials.

Golgibody is single membrane bound cell organelle.



Function:–

(i) It involved in cell-secretion and acts as storage, modification and condensation or **packaging membrane**.

(ii) It forms the **Acrosome** of sperm [**Acrosome :-** A bag like structure filled with lytic enzymes which dissolve egg membrane at the time of fertilization]

(iii) It forms the lysosomes and secretory vesicles.

(iv) It is the site for formation of glycolipids and glycoproteins.

(v) Synthesis of cell wall material (Polysaccharide synthesis)

(vi) Cell plate formation (phragmoplast) during cell formation.

(vii) **Vitelline membrane of egg** is secreted by Golgi body.

LYSOSOME

First observed and the term coined by **Christian De Duve (1955)**

- Lysosomes are spherical bag like structures [0.1 – 0.8 µm] which is covered by single unit membrane.**With the exception of mammalian RBC** they are reported from all cells. Lysosomes are filled about 50 different types of digestive enzymes termed as **acid hydrolases.**
- **Lysosomes are highly polymorphic cell organelle**. Because, during functioning, lysosomes have different morphological and physiological states.

Types of Lysosomes

- **Primary lysosomes or storage granules –** These lysosomes store enzyme Acid Hydrolases in their inactive form. These are newly formed lysosome.
- **Digestive vacuoles or Heterophagosomes –** These lysosome forms by the fusion of primary lysosomes and phagosomes. These are also called **secondary lysosomes.**
- **Residual bodies –** Lysosomes containing undigested material are called **residual bodies.** These may be eliminated by exocytosis. These are also called as Telolysosomes. **(Tertiary lysosomes)**
- **Autophagic lysosomes or cytolysosomes or autophagosomes –** Lysosomes which digest cell organelles are known as **Autophagosomes.**

Functions :–

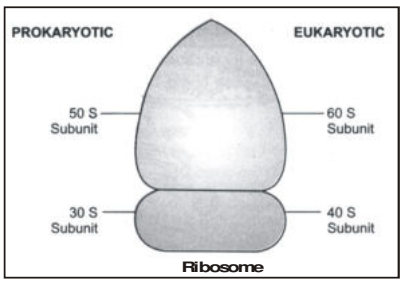
(i) Heterophagy :– It involve in digestion of foreign materials received in cell.

(ii) Autophagy :– Digestion of old or dead cell organelles.

(iii) Cellular digestion (Autolysis) :– Sometimes all lysosomes of a cell burst to dissolve the cell completely.

That's why lysosomes also known as **suicidal bags.**

RIBOSOME-ENGINE OF CELL

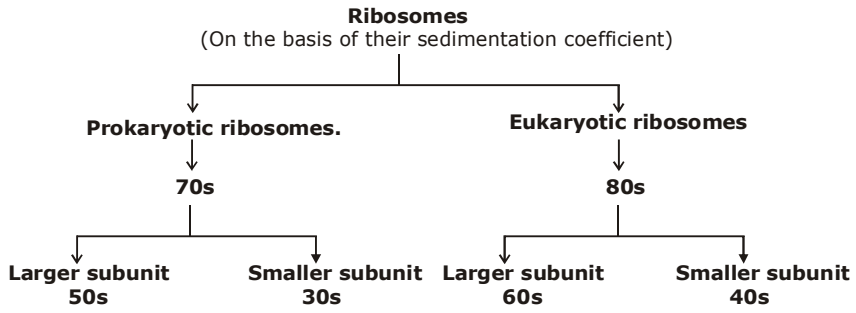


Chemically a ribosome is made of proteins and RNA.

- ✧ First reported by Claude and named by G.P alade.
- ✧ They are small granular structures visible only under electro microscope.
- ✧ They are the only organelles which are present in all types of cells.
- ✧ They help in protein synthesis and are known as 'protein factories'.
- ✧ Each ribosomes consists of two unequal subunits, larger dome shaped and small ovoid.

The size of ribosome is determined by sedimentation coefficient in the centrifuge.

The cytoplasmic ribosomes of eukaryotes are 80S and in prokaryotes and cell organelles like mitochondria and chloroplast it is 70S type. The two sub units of 80S ribosomes are 60S and 40S while 70S type ribosomes have 50S and 30S subunits.



- Magnesium ion [Mg^{++}] is essential for binding of both the sub units of ribosome.

Functions :–

Site of protein synthesis, so these are also called **protein factories**.

Peroxisomes/Uricosomes.

- Discovered by **Rhodin & Tolbert.**
- Peroxisome term was first used by **De Duve.**

It contains per-oxide forming enzymes.

Functions :–

(i) In animals peroxisomes are concerned with β-oxidation of fatty acids & peroxide metabolism.

(ii) In plants peroxisomes are concerned with **β-oxidation of fatty acids, peroxide metabolism and photorespiration.**

COMPETITION WINDOW

- Scattered Golgibodies in the cytoplasm of plant cells are also called **Dictyosomes.**
- Lysosome found in four forms that's why it is also called **polymorphic cell organelle.**
- Chloroplasts are centres of photosynthesis to prepare the organic food so are called **kitchens of the cells.**

VACUOLES

- Vacuoles of animal cells arise from Golgi-complex.
- **Tonoplast:–** Plasma membrane that covers the vacuole is called tonoplast.

Vacuoles are of three types :-

1. **Food vacuole** – The vacuole which contain food material.
2. **Sap vacuole** – The vacuole which is filled by liquid material [sap]
3. **Contratile vacuole** – The vacuole that concern with osmoregulation e.g. *Amoeba*

Functions :–

(i) Storage of food, water and other substences.

(ii) They help in the elimination of excess water from the cell **(osmoregulation)**, and maintains internal pressure of the cell

Centrosome :– Discovered by **Benden. Boveri** named it as centrosome.

- Centrosome is generally found in animal cells. Only few type of a plant cells show its presence.
- It is situated near the nucleus of the cell and shaped like star.
- Each centrosome has two centrioles. The two centrioles are placed perpendicular to each other.
- Cytoplasm which surrounds centrioles called as **"Centrosphere"**. Centrioles and centrosphere collectively called **centrosome or microcentrum or diplosome.**

Function :–

(i) In animal cells centrioles play important role in initiation of cell division by arranging spindle fibres between two poles of cell.

(ii) The location of centrioles during cell division decides the **plane of division.**

(iii) It form the **basal granule of cilia and flagella** in micro-organisms, zoo-spores & motile gametes.

(iv) Form tail of sperm.

◈ **Cytoskeleton (Cilia and flagella) :**

(i) In many eukaryotic as well as prokaryotic cells of both plants and animals a cytoskeleton has been reported in recent years.

(ii) The elements of this cytoskeleton are proteins.

(iii) The cytoskeleton consists of following two elements within a cell.

(a) Microtubules

(b) Microfilaments

(iv) Cilia and flagella of eukaryotic cells are microscopic, contractile & filamentous process of cytoplasm.

(v) Cilia is shorter than flagella and are numerous.

◈ **Microtubules & Microfilaments :**

(A) Microtubules :

***Introduction* :**

(i) These are cylindrical structures formed by the polymerization of two-part subunits of globular protein tubulin into helical stacks.

Historical Account :

The term **'microtubule'** was coined by **Slautterback** in 1963.

Ultrastructure :

(i) Microtubles radiate from each end of the cell. Which helps in the movement of chromosomes.

(ii) These are found in many plant and animal cells.

- **Function :**

(i) Microtubules help in the structure and movement of cillia and flagella.

(ii) It also play a role in cell division.

(B) Microfilaments :

Ultrastructure *:*

(i) These are long and helically intertwined polymers. Microfilaments are made up of protein **actin.**

- **Function :**

(i) These filaments help in cell movement and in formation of cell furrow and cell plate.

CELL DIVISION

(i) Cell multiplication is needed for the growth, development and repair of the body. Cell multiplies by dividing itself again and again this process called **cell division**.

(ii) Cell divisions are two types

(a) Mitosis (b) Meiosis

MITOSIS

Stages of Mitosis :

Interphase, prophase, metaphase, anaphase and telophase are roughly the five stages or phases of mitosis.

(a) Interphase :

(i) The period between one cell division and the next is called **interphase** in which the cell is said to be in the resting stage.

(ii) Interphase, however, includes three phases, i.e. G1-phase, S-phase and G2-phase. G1-phase is a resting phase or pre-DNA synthesis phase.

(iii) During S-phase, DNA synthesis takes place. G2-phase is again a resting phase and it may be described as a post-DNA synthesis phase.

(iv) The main mitosis division takes place during M-phase which involves prophase, metaphase, anaphase and telophase.

(b) Prophase :

(i) Prophase is actually the first and the longest phase in the mitosis cell division.

(ii) Chromosomes become visible in the nucleus as short, thick and helically-coiled threads.

(iii) Each chromosome splits into two chromatids joined at the centromere.

(iv) Nuclear membrane dissolves away.

(v) Nucleolus also dissolves away and finally disappears.

(c) Metaphase :

(i) It is the second stage in the mitotic cell division.

(ii) Nuclear membrane and nucleolus disintegrate and they are lost completely.

(iii) Spindle tubules start appearing, and these tubules get attached to chromosomes at the centromeres.

(iv) Chromosomes move actively, become shorter and thicker and arrange themselves in the centre or on the equator of the spindle.

(v) Separation of the two chromatids from each chromosomes also begins at the end of metaphase.

(d) Anaphase :

(i) It is the third stage of mitosis.

(ii) Chromatids separate from each other at centromeres.

(iii) Separated sister chromatids, each with a centromere, are called daughter chromosomes. They move to the ends of opposite poles of the spindle.

(iv) Daughter chromosomeres appear in V, U or J-shaped during their movement towards the poles.

(v) During the late anaphase stage, the cell starts constricting in the middle region.

(e) Telophase :

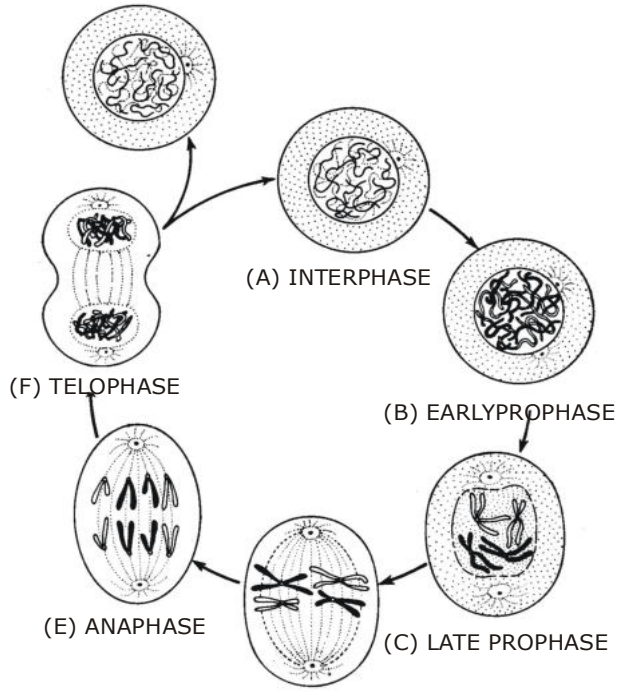
(i) Telophase is the last stage of mitotic cell division.

(ii) Chromatids or daughter chromosomes are now at the end of the spindle.

(iii) Nuclear membranes and nucleoli reform around each group of chromosomes and thus two new nuclei are reorganized at each pole.

(iv) Chromosomes begin to lose their compact structure.

(v) Spindle Xapparatus disappears gradually.



VARIOUS STAGES OF MITROSIS

◈ **Karyokinesis :**

Division of nucleus is called **karyokinesis** and, the process of the division of cytoplasm is called cytokinesis.

(i) In animal cells, a circular constriction appears at the equator, the constriction deepens and eventually divides the cell into two.

(ii) In plant, there is no constriction. A cell plate or new cell wall forms across the cell resulting in the separation of two daughter cells.

Significance of Mitosis :

(i) Mitosis occurs during the growth and development of multicellular plants and animals.

(ii) Mitosis ensures that the two daughter cells inherit the same number of chromosomes.

(iii) It helps the cell in maintaining proper size.

(iv) In unicellular organisms mitosis helps in asexual reproduction during which two or more individuals arise from the mother cell.

(v) If mitosis becomes uncontrolled it may cause tumour or cancerous growth.

MEIOSIS

(i) **Meiosis is also called reduction division** because the chromosomes in this division are reduced from the diploid to the haploid number.

(ii) Meiosis occurs in all organisms which reproduce sexually.

(iii) Meiosis produces haploid sex cells from diploid cells.

(iv) Meiosis involves two cell division, viz., meiosis I and meiosis II.

(v) In meiosis I, the replicated homologous chromosomes pair with each other on the spindle, cross over and then separate to either end of the spindle.

(vi) On the other hand, in meiosis II, the chromatids of each chromosome move towards the centromere, and these chromatids separate at each end of the second spindle.

(vii) As a result of this process, a diploid cell divides to form four haploid cells.

First Meiosis Division :

First meiosis division is actually the reduction division. It consists of prophase I, metaphase I, anaphase I and telophase I.

(a) Prophase I :

(i) Prophase I is the longest phase of meiosis and includes five sub-phases.

(i) Leptotene :

(i) This is the first stage in the first meiosis prophase.

(ii) In this stage, the chromosomes appear as separate thin and fine thread-like structures.

(ii) Zygotene :

(i) Homologous chromosomes come together, or arrange themselves side by side in pairs to form bivalents.

(ii) This **pairing of homologous chromosomes** during zygotene in the first meiosis prophase is called **synapsis**.

(iii) Pachytene :

(i) The bivalents or chromosomes become shorter and thicker.

(ii) They replicate or split into chromatids but remain linked at the centromeres.

(iii) Each bivalent thus now consists of four chromatids.

(iv) **Crossing over** between non-sister chromatids of homologous pair takes place.

(iv) Diplotene :

(i) The centromeres of paired chromosomes or bivalents move away from each other and crossing over can also be seen.

(ii) The points in a bivalent where the two chromosomes appear to be joined and crossed over are called **chiasmata**.

(iii) Chiasmata formation and crossing over are the distinguishing features of diplotene.

(v) Diakinesis :

(i) This is the last stage of first meiosis prophase.

(ii) The chromosomes become shortest and thickest.

(iii) **Terminalisation of chiasmata**.

(iv) Nuclear membrane starts disintegrating. Nucleolus also disintegrates. Diakinesis followed by metaphase I.

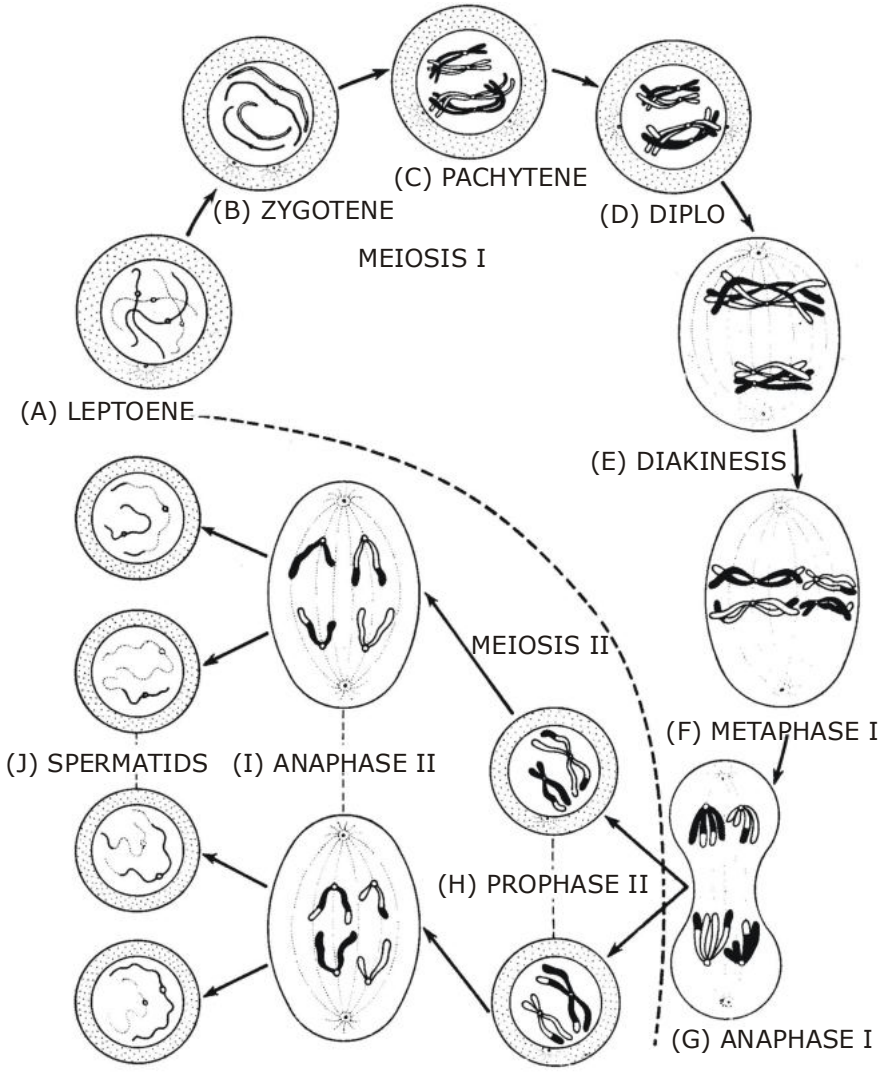
(b) Metaphase I :

(i) Nuclear membrane disappears completely at the beginning of metaphase I.

(ii) Pairs of homologous chromosomes are lined up at the centre.

(iii) Spindle apparatus starts appearing. Few spindle fibres get attached with the centromeres of chromosomes.

(iv) Metaphase I change into anaphase I.



DIFFERENTSTAGES OF MEIOSIS

(c) Anaphase I :

(i) Partners of homologous chromosomes separate completely and move to opposites poles of spindle during anaphase I, which in turn changes into telophase I.

(d) Telophase I :

(i) The separated partners of homologous chromosomes collect at the poles of the spindle and nuclear membranes form around them. Two daughter haploid nuclei are thus formed. The chromosomes lengthen as they uncoil. Nucleoli start reappearing.

Second Meiosis Division :

Like mitosis, the second meiosis divisions also consists of four phases, i.e. prophase II, metaphase II, anaphase II and telophase II.

- **Prophase II :**

(i) In both the haploid nuclei, each chromosome splits up into two chromatids with a single functional centromere. The nuclear membrane and nucleolus disintegrate partially or completely.

- **Metaphase II :**

(i) The chromatids arrange themselves at metaphase plate or spindle.

- **Anaphase II :**

(i) During anaphase II, the centromere splits. The two chromatids belonging to each chromosomes may now be called chromosomes and pass to the two opposite poles of spindle.

- **Telophase II :**

(i) The haploid set of chromosomes at two different poles of spindle uncoil and form chromatin material. Nuclear membrane forms around each haploid set of chromosomes. Nucleolus also reappears.

Significance of Meiosis :

(i) Meiosis results in the formation of haploid gametes (sperm and ovum)

(ii) The phenomenon of crossing over provides new combinations of chromosomes and, hence new combinations of genes and also of characters in offspring.

(iii)The four chromatids of a homologous pair of chromosomes are passed on to four different daughter cells. This is called the segregation of chromosomes. This causes genetic variations in daughter cells.

(iv)Failure of meiosis leads to the formation of diploid gametes which on fusion form polyploids.

DIFFERENCE BETWEEN MITOSIS AND MEIOSIS CELL DIVISION ::

Special Note :

Besides mitosis and meiosis, there is also a third type of division. It is called **amitosis**. It is a direct division of the nucleus by constriction.

S.No.	Mitosis	Meiosis
1	It occurs in all somatic cells.	It occurs in reproductive cells (germ cells or sex cells)
2	In the resultant daughter cells, the number of chromosomes remains the same (i.e. diploid) hence called equational division.	In resultant daughter cells the number of chromosomes reduces to half (i.e. haploid) hence, called reductional division.
3	By mitosis two daughter cells are produced.	By meiosis, four daughter cells are produced.
4	During mitosis no crossing over takes place.	During meiosis crossing over take place.
5	Daughter cells have identical chromosomes which are also identical to that of parent cell (i.e., remains constant)	Chromosomes of the daughter cells are with combined components (genes) of both parents (i.e. genetic variability occurs)

SOLVED PROBLEMS

Q.1 Plasma membrane is made up of which two components?

Sol. The two components are lipids and proteins.

Q.2 Cell wall is made up of which components?

Sol. Cell wall is made up of cellulose.

Q.3 Give an example of unicellular organism.

Sol. Amoeba, Bacteria, Paramedium.

Q.4 What is the intracellular source of digestive enzyme?

Sol. Lysosome.

Q.5 What is the function of mitochondria?

Sol. Mitochondria are sites of cellular respiration in which energy, i.e., packets of ATP are formed.

Q.6 Name two structures found in animal cells but not in plant cells.

Sol. Lysosomes and Centrioles.

Q.7 Give the name of colourless plastids.

Sol. Leucoplast.

Q.8 What is plasmolysis?

Sol. The shrinkage of protoplasm away from cell wall due to loss of water by osmosis when the cell is kept in hypoertonic medium.

Q.9 What is the function of the cell wall?

Sol. The cell wall lies outside the plasma membrane and is responsible for providing structural strength to the plants.

Q.10 There would be no plant life in chloroplasts did not exist. Justify.

Sol. Chloroplast contains the pigment chlorophyll which is responsible for food preparation by photosynthesis in plants. Hence, if there were no chloroplasts then there would not have been any plant life.

Q.11 Why the Golgi apparatus is called the secretary organelle of the cell?

Sol. This is because it packages material synthesised in the ER and dispatches it to intracellular (plasma membrane and lysosomes) and extracellular (cell surface) targets.

Q.12 Differentiate between smooth and rough endoplasmic reticulum.

Sol. Differences between Smooth and Rough Endoplasmic Reticulum are

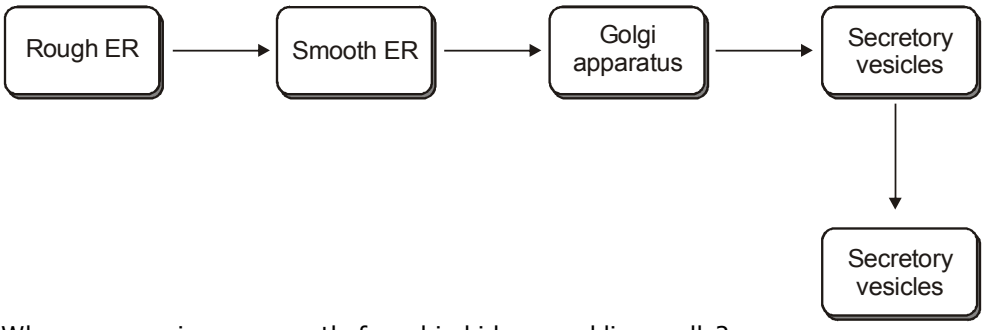
Rough endoplasmic reticulum	Smooth endoplasmic reticulum
1. They have ribosomes attached on their surface.	1. They don't have ribosomes attached on their surfaces.
2. RER manufactures proteins and transport them to various places.	2. SER helps in manufacturing lipids and transport them to various places.

Q.13 What is Cytosol and Cytoskeletone?

Sol. Cytosol is the semi-fluid part of the cell cytoplasm which is embedded with organelles. Cytoskeletone is a network of fibres present in the cell which provides a supporting framework for the organelles.

Q.14 What is membrane biogenesis? How plasma membrane is formed during this process?

Sol. The process of plasma membrane formation is called membrane biogenesis.



Q.15 Why are peroxisomes mostly found in kidney and liver cells?

Sol. Peroxisomes contain various oxidative enzymes which detoxify the toxic material.

Since the blood carries various toxic substances to kidney and liver, a large number of peroxisomes are present in them to oxidise the toxid material.

Q.16 What is the difference between plant cell and animal cell?

Sol.

Plant cell	Animal Cell
1. Plant cell has rigid cell wall.	1. Cell wall is absent
2. It can't change its shape.	2. An animal cell can often change its shape.
3. Plastics are present.	3. Plastics are usually absent.
4. A mature plant cell contains a large central vacuole.	4. Generally absent but may possess many small vacuoles.
5. Nucleus lies on one side in the peripheral cytoplasm.	5. Nucleus usually lies in the centre.
6. Nucleus is usually elliptical.	6. Nucleus is usually round.
7. Plant cells do not burst if placed in hypotonic solution due to the presence of cell wall.	7. Animal cell usually burst, if placed in hypotonic solution.
8. Centrioles are usually absent except in lower plants.	8. Centrioles are found in animal cell.
9. The cell can't take part in phagocytosis	9. It can ingest material through phagocytosis.

Q.17 What is the active transport? Differentiate between active and passive transport.

Sol. The process in which the molecules are moved uphill against the concentration gradient. Active transport always involves the expenditure of energy because the materials are pumped against the concentration gradient.

Active transport	Passive transport
1. It involves movement of molecules against the concentration gradient.	1. It involves movement of molecules along the concentration gradient.
2. It requires energy in the form of ATP molecule.	2. No energy is required
3. It is a rapid movement.	3. It is a slow movement.
4. Movement of large molecules occurs by active transport.	4. Small molecules or water molecules only are transported passively.

EXERCISE – I BOARD PROBLEMS

Q.1 Who discovered cells and how ?

Q.2 Why the cell is called the structural and functional unit of life ?

Q.3 How substances like carbon dioxide and water move in and out of the cell ?

Q.4 Why is the plasma membrane called a selectively permeable membranes ?

Q.5 Fill in the gaps in the following difference between prokaryotic and eukaryotic cells.

Q.6 Can you mane the two organelles we have studied that contain their own genetic material?

Q.7 If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen ?

Q.8 Why are lysosomes known as suicidal bags ?

Q.9 Where are protein systhesised inside the cell ?

Q.10 Plasmas membrane is made up of which two components ?

Q.11 What is hypotonic solution ?

Q.12 What is hypertonic solution ?

Q.13 What is isotonic solution ?

Q.14 Cell wall is made up of which component ?

Q.15 Give an example of unicellular organism.

Q.16 Give an example of multicelluar organism.

Q.17 What is active transport ?

Q.18 What is the intracellular source of digestive enzyme ?

Q.19 What is endocytosis ?

Q.20 What is the function of mitochondria ?

Q.21 What does ATP stand for ?

Q.22 Which cell organelle is responsible for the release of energy as ATP ?

Q.23 Where are genes located ?

Q.24 Name two structures found in plant cells but not in animal cells.

Q.25 Name two structures found in animal cells but not in plant cells.

Q.26 Give the name of colourless plastids.

Q.27 What is membrane biogenesis ?

Q.28 Which organelle is involved in the formation of lysosomes ?

Q.29 Which organelle is responsible for the storage, modification and packaging of produce in vesiscles ?

Q.30 What is the outermost layer found in animal cells ?

Q.31 What is the outermost layer found in the plant cell ?

Q.32 Which organelle helps in photosynthesis ?

Q.33 Which organelle is the storage sac of solid and liquid materials ?

Q.34 Which organelle serves as a channel for transport of materials between cytoplasm and nucleus ?

Q.35 What is microscope ?

Q.36 Why light microscope is called a compound microscope ?

Q.37 What are cell organelles ?

Q.38 Which organelle digests unwanted organic substances ?

Q.39 Which organelle helps in protein synthesis ?

Q.40 Which organelle is associated with ribosome formations ?

EXERCISE – II OLYMPIAD QUESTIONS

Q.1 Double membrane is absent in –

(A) Mitochondrion (B) Chloroplast
(C) Nucleus (D) Lysosome

Q.2 Animal cell is limited by–

(A) Plasma membrane

(B) Shell membrane

(C) Cell wall

(D) Basement membrane

Q.3 The radiant energy of sunlight is converted to chemical energy and stored as –

(A) AMP (B) ADP
(C) ATP (D) APP

Q.4 Root hair absorbs water from soil through –

(A) Osmosis (B) Active transport
(C) Diffusion (D) Endocytosis

Q.5 The barrier between the protoplasm and outer environment in a plant cell is –

(A) Cell membrane (B) Nuclear membrane
(C) Cell wall (D) Tonoplast

Q.6 An animal cell differs from a plant cell in respect of –

(A) ER (B) Cell wall
(C) Ribosomes (D) Cell membrane.

Q.7 If the nucleus is a cell's "control centre" and chloroplasts its "solar collectors". Which of the following might be called the cell's combination "food processor" and "garbage disposer"?

(A) Lysosome (B) Ribosome
(C) Golgi apparatus (D) Nucleolus

Q.8 The longest cell in human body is –

(A) Neuron (B) Muscle fibre
(C) Epithelial cell (D) Bone cell

Q.9 Identify human cells which lack nucleus–

(A) WBC (B) RBC
(C) Platelets (D) Nerve cells

Q.10 The energy currency of a cell is –

(A) ADP (B) AMP
(C) ATP (D) CTP

Q.11 Which organelle releases oxygen?

(A) Ribosome (B) Golgi apparatus
(C) Mitochondria (D) Chloroplast.

Q.12 The term "protoplasm" to the living substance present inside the cell, was given by

(A) Robert Hooke (B) Robert Brown
(C) J.E. Purkinje (D) W.Flemming

Q.13 Ribosomes are the centre for –

(A) Respiration (B) Photosynthesis
(C) Protein synthesis (D) Fat synthesis.

Q.14 Lysosomes are the reservoirs of

(A) Fat

(B) RNA

(C) Secretory glycoproteins

(D) Hydrolytic enzymes.

Q.15 The membrane surrounding the vacuole of a plant cell is called

(A) Tonoplast (B) Plasma membrane
(C) Nuclear membrane (D) Cell wall

Q.16 Centriole is associated with –

(A) DNA synthesis (B) Reproduction
(C) Spindle formation (D) Respiration

Q.17 The cell organelle associated with cell secretion is

(A) Plastids (B) Mitochondria
(C) Golgi apparatus (D) Nucleolus

Q.18 Which of the following is an inclusion?

(A) Mitochondrion (B) Lysosome
(C) Golgi complex (D) Starch grain

Q.19 Which of the following would not be considered part of a cell's cytoplsm?

(A) Ribosome (B) Nucleus
(C) Mitochondrion (D) Microtubule

Q.20 Which of the following is called the brain of the cell?

(A) Nucleus (B) Mitochondria
(C) Ribosomes (D) Plasma membrane

Q.21 Which one is not a part of nucleus?

(A) Chromatin (B) Nucleolus
(C) Centrosome (D) Nucleoplasm

Q.22 The common feature amongst nucleus, chloroplast and mitochondrion is –

(A) DNA (B) Lamellae
(C) Cristae (D) All of these

Q.23 Nucleus is separated from surrounding cytoplasm by a nuclear envelope which is –

(A) Single and porous
(B) Double and porous
(C) Single and nonporous
(D) Double and nonporous

Q.24 Nucleoplasm is continuous with cytoplasm through –

(A) Centriole
(B) Golgi apparatus
(C) Nuclear pores
(D) Endoplasmic reticulum

Q.25 Nucleolus was discovered by

(A) Fontana (B) Schleiden
(C) Altmann (D) Robert Brown

Q.26 The function of the nucleolus in the cell is

(A) Secretory
(B) Synthesis of DNA
(C) Synthesis of RNA and ribosomes
(D) None of these

Q.27 Which of the following phenomena is commonly referred as 'cell drinking'?

(A) Exocytosis (B) Pinocytosis
(C) Endocytosis (D) Phagocytosis

Q.28 The cell organelle taking part in photorespiration is

(A) Glyoxysome
(B) Dictyosome
(C) Peroxisome
(D) Endoplasmic reticulum

Q.29 Endoplasmic reticulum sometime contains –

(A) Ribosomes (B) Lysosomes
(C) Golgi bodies (D) None of these

Q.30 Ribosomes are composed of –

(A) 1 subunit (B) 5 subunits
(C) 2 subunits (D) 4 subunits

Q.31 In chloroplasts, chlorophyll is present in the–

(A) Stroma (B) thylakoids
(C) Outer membrane (D) Inner membrane

Q.32 The sedimentation coefficient of complete ribosome in bacterial cell is

(A) 70S (B) 80S
(C) 78S (D) 60S

Q.33 Which one of the following is common in plant and animal?

(A) Mitochondria (B) chloroplast
(C) Centriole (D) Cell wall

Q.34 Which of the following is a nonliving cell inclusion?

(A) Vacuoles (B) Ribosomes
(C) Centrosomes (D) Golgi complex

Q.35 Cell vacuole contains

(A) Water
(B) Metabolic gases
(C) Cytoplasm
(D) Water and dissolved substances

Q.36 A mature plant cell has –

(A) Protoplasm and vacuole
(B) Vacuole and cell wall
(C) Cell wall and protoplasm
(D) Protoplasm, cell wall and vacuole

Q.37 Centriole takes part in –

(A) Cell plate formation

(B) Spindle formation

(C) Nucleolus formation

(D) Start of cell division

Q.38 Which of the following is called 'an organelle within an organelle'? –

(A) Plastid (B) Ribosome

(C) Lysosome (D) Microsome

Q.39 Cell organelle common in Protista and Monera is –

(A) Vacuole (B) Ribosome

(C) Lysosome (D) Chloroplast

Q.40 Which of the following organelles lack membranes?

(A) Ribosome (B) Mitochondria

(C) Golgi complex (D) Nucleus

Q.41 Besides cellulose microfibrils, the other two cell wall networks are :-

(A) Protein and hemicellulose

(B) Hemicellulose and protein

(C) Pectin and glycoprotein

(D) Pectin and hemicellulose

Q.42 Middle lamella occurs :-

(A) Inner to primary wall

(B) Inner to secondary wall

(C) Outer to secondary wall

(D) Outer to primary wall

Q.43 Hydrophilic chemical of cell wall is :-

(A) Pectin (B) Suberin

(C) Fat (D) Lignin

Q.44 Structural element of cell wall is :-

(A) Matrix

(B) Microfibrils

(C) Microtubules

(D) Arabinogalactans

Q.45 Different layers of cell wall are :-

(A) Middle lamella and primary wall

(B) Primary wall and secondary wall

(C) Middle lamella, primary wall and secondary wall

(D) Wall layers exclude middle lamella

Q.46 The first wall layer of cell is :-

(A) Tertiary wall, if present

(B) Secondary wall

(C) Primary wall

(D) Middle lamella, if present

Q.47 Plant cells are distinguishable from animal cell in containing :-

(A) Mitochondria (B) Ribosomes

(C) E.R. (D) Cell wall

Q.48 Ripe fruits soften due to :-

(A) Degeneration of cell walls

(B) Partial solubilisation of pectic compounds

(C) Metabolism of tannins

(D) Exosmosis

Q.49 Ribosomes contain large quantities of :-

(A) haemoglobin (B) fatty acid

(C) ribonucleic acid (D) deoxyribonucleic acid

Q.50 Glycocalyx is :-

(A) Glycoproteins and glycolipids

(B) Oligosaccharide part of glycolipids and glycoproteins

(C) Lipid and protein parts of glycolipids

(D) Mucopolysaccharides attached to cell wall

Q.51 Which of the following organelles lack membranes ?

(A) Ribosome (B) Lysosome

(C) Golgi body (D) Nucleus

Q.52 Protein synthesis occurs on :-

(A) ribosome (B) nucleus

(C) lysosome (D) centrosome

Q.53 The term protoplasm was coined by :-

(A) Huxley (B) Purkinje

(C) Dujardin (D) Schultze

Q.54 A unit of protoplasm having a nucleus and covered by plasmalemma is called :-

(A) Ectoplast (B) Cell

(C) Cytoplast (D) All the above

Q.55 The term cytoplasm was coined by :-

(A) Sachs (B) Strasburger

(C) Hanstein (D) Flemming

Q.56 Which of the following is correct for prokaryotic ribosome :-

(A) it dissociates into 50S and 30S

(B) it dissociates into 40S and 40S

(C) it dissociates into 60S and 20S

(D) it dissociates into 70S and 30S

Q.57 Golgi apparatus takes part in synthesis of :-

(A) Glycolipids (B) Glycoproteins

(C) Hormones (D) All the above

Q.58 In a cell DNA is found in :-

(A) nucleus, mitochondria and plastid

(B) nucleus, mitochondria and Golgi body

(C) mitochondria, Golgi body and plastid

(D) nucleus, Golgi body and plastid

Q.59 Cartilage matrix is digested during its osteogenesis through :-

(A) Intracellular autophagic activity

(B) Extracellular lysosomal activity

(C) Intracellular heterophagic activity

(D) Both B and C

Q.60 Which one is lysosomal activity :-

(A) Reabsorption of tadpole tail

(B) Mobilisation of stored substances

(C) Removal of obstructions

(D) All the above

Q.61 When are lysosomes extra-active :-

(A) Seed maturation (B) Seed germination

(C) Flowering (D) Fruiting

Q.62 In animal cell, a mitochondrion is :-

(A) Largest organelle

(B) Second largest organelle

(C) Third largest organalle

(D) None of the above.

Q.63 Outer mitochondrial membrane resembles bacterial membrane and outer chloroplast membrane in having :-

(A) Selective permeability

(B) Single ion channels

(C) Porin

(D) All the above

Q.64 Chromoplasts are formed from chloroplasts during :-

(A) Ripening of Tomato

(B) Ripening of Chilli

(C) Development carrot

(D) Both A and B

Q.65 Experiments on *Acetabularia* by Hammerling proved the role of :-

(A) nucleus in heredity

(B) nucleoplasmic ratio

(C) chromosomes in heredity

(D) cytoplasm in controlling differentiation

Q.66 The plastids with irregular shape are :-

(A) Leucoplasts

(B) Chloroplasts

(C) Chromoplasts

(D) Amyloplasts

Q.67 Peroxisomes and glyoxisomes are :-

(A) Energy transforming organelles

(B) Membrane-less organelles

(C) Macrobodies

(D) Microbodies

Q.68 Structure of nuclear envelope facilitates :-

(A) spindle organization

(B) separation of daughter chromosomes

(C) synapsis of homologous chromosomes

(D) nucleocytoplasmic exchange of materials

Q.69 Microfilaments were discovered by :-

(A) Slautterback (B) Paleviz *et al*

(C) Altman (D) Ledbetter and Porter

Q.70 Microfilaments are required for :-

(A) Movement of flagella and cilia

(B) Cell polarity

(C) Sol-gel changes

(D) All the above

Q.71 Cell polarity is determined by :-

(A) Intermediate filaments

(B) Microtubules

(C) Protofilaments

(D) Centrioles

Q.72 Who coined the term 'Nucleolus' ?

(A) Brown (B) Hooke

(C) Fontana (D) Bowman

Q.73 Which of the following phenomena is commonly referred as 'cell drinking' ?

(A) Exocytosis (B) Pinocytosis

(C) Endocytosis (D) Phagocytosis

Q.74 The two centrioles of a pair occur :-

(A) Parallel to each other

(B) At right angles to each other

(C) At an angle other than 90°

(D) End to end

Q.75 Cell organelle having a cartwheel constitution is :-

(A) Centriole and basal body

(B) Microtubule

(C) Microfilament

(D) Basal plate

Q.76 A flagellum beats :-

(A) Independently, undulatory and asymmetrically

(B)Independently, undulatory and symmetrically

(C) Coordinated, pendular and symmetric

(D) Coordinated, pendular and asymmetric

Q.77 Food vacuole is formed from :-

(A) Absorbed and digested food

(B) Phagosome + Lysosome

(C) Feeding canals + Lysosome

(D) Feeding canals + Phagosome

Q.78 Chromatin material which remains condensed during interphase is called :-

(A) Heterochromatin (B) Euchromatin

(C) Chromonemata (D) Megachromatin

Q.79 Nucleolus was discovered by :-

(A) Robert Brown (B) Leeuwenhoek

(C) Robert Hooke (D) Fontana

Q.80 Nucleolus is formed from :-

(A) Nucleus

(B) nuclear sap

(C) Sat chromosome

(D) Giant chromosome

Q.81 Components of nucleus are :-

(A) Karyotheca, nucleolus, chromatin, nucleoplasm and nuclear matrix

(B) Nuclear envelope, nucleolus and chromatin

(C) Nuclear envelope, nucleoplasm and chromatin

(D) All the above

Q.82 Which one of the following pairs is not correctly matched ?

(A) Nucleus - Genetic information

(B) Cell membrane - Permeability

(C) Golgi complex - Secretion

(D) Microtubular organelles - Glycolysis

Q.83 Calcium is deposited in plant cells as :-

(A) Calcium carbonate

(B) Calcium oxalate

(C) Calcium sulphate

(D) All the above

Q.84 What is the latest and most acceptable model of cell membranes :-

(A) Lamellar model

(B) Fluid mosaic model

(C) Micellar model

(D) Unit membrane concept

Q.85 Cell membrane is composed of :-

(A) Phospholipid (B) Nucleoprotein
(C) Polysaccharides (D) Lipoprotein

Q.86 In a membrane phospholipid, there are :-

(A) One polar head and two nonpolar tails

(B) Two polar heads and one nonpolar tail

(C) One nonpolar head and two polar tails

(D) Two nonpolar heads and one polar tail

Q.87 Extrinsic proteins of cell membrane are :-

(A) Present superficially and are easily separable

(B) Present superficially but are not separable

(C) Attached to intrinsic proteins but are easily separable

(D) Attached to intrinsic proteins and are not easily separable

Q.88 Main function of plasma membrane is to :-

(A) Control cell movements

(B) Control cell activities

(C) Maintain cell shape and size

(D) Regulate exchange of materials

Q.89 The process of taking in liquid material by infolding of membrane is known as :-

(A) Phagocytosis (B) Osmosis
(C) Active transport (D) Pinocytosis

Q.90 Active transport across biomembrane involves:-

(i) Production of ATP

(ii) Requirement of energy

(iii) Production of toxin

(iv) Release of energy

(A) light microscope (B) electron microscope
(C) both of these (D) none of these

Answers

1.	D	**2.**	A	**3.**	C	**4.**	A
5.	C	**6.**	B	**7.**	A	**8.**	A
9.	B	**10.**	C	**11.**	D	**12.**	C
13.	C	**14.**	D	**15.**	A	**16.**	C
17.	C	**18.**	D	**19.**	B	**20.**	A
21.	C	**22.**	A	**23.**	B	**24.**	C
25.	A	**26.**	C	**27.**	B	**28.**	C
29.	A	**30.**	C	**31.**	B	**32.**	A
33.	A	**34.**	A	**35.**	D	**36.**	D
37.	D	**38.**	B	**39.**	B	**40.**	A
41.	C	**42.**	D	**43.**	A	**44.**	B
45.	B	**46.**	C	**47.**	D	**48.**	B
49.	C	**50.**	B	**51.**	A	**52.**	A
53.	B	**54.**	C	**55.**	B	**56.**	A
57.	D	**58.**	A	**59.**	B	**60.**	D
61.	B	**62.**	A	**63.**	A	**64.**	D
65.	A	**66.**	C	**67.**	D	**68.**	D
69.	B	**70.**	D	**71.**	B	**72.**	D
73.	B	**74.**	B	**75.**	A	**76.**	B
77.	B	**78.**	A	**79.**	D	**80.**	C
81.	A	**82.**	D	**83.**	D	**84.**	B
85.	D	**86.**	A	**87.**	A	**88.**	D
89.	D	**90.**	B				

TISSUES

Tissues

A group of cells that are similar in structure and work together to achieve a particular function forms a tissue. it is a cluster of cells arranged and designed, so as to give the highest possible efficiency of function. Blood, phloem and muscle are examples of tissues. Tissues become organised to form organs.

Plant Tissues

Plant tissues are based on their fixed habit and mainly provide support to point plant.

Meristematic Tissues

The tissues whose cells divide activity throughout the life. They are found in I the growing region of plant like roet and sheet trip. These tissues are living and bring about an increase in length and girth of the plant.

Types of Meristematic Tissues

1. Apical Meristem Present at growing tips of stems and roots.
2. Intercalary Meristem Present at base of the leaves or internodes on twigs.
3. Lateral Meristem Present on the lateral sides of stems and roots.

Permanent Tissues

These tissues do not divide. They takes up permanent shape, size and function . There are formed from , meristematic tissue when they loose the ability to divide.

Simple permanent tissues

These are made up of only one type of cell.

1. Parenchyma Simplest form of tissue with little specia lisation. These provide support to plants and also stores food.
2. Collenchyma Cells are living, elongated and irregularly thickened at the corners, generally found in leaf stocks below the epidermis. These provide mechanical support and elasticity in plants.
3. Sclerenchyma Present in stems around vascular bundles in the veins of leaves and in the hard covering of seeds and nuts. These provide strength and enables them to bear various stresses.

Complex permanent tissues

They are made up of more than one type of cells

1. Xylem A Vascular and mechanical conducting tissue, also known as wood. Responsible for transport of water and minera Is from roots to other parts.
2. Phloem A vascular tissue also known as bast, responsible for transport of food from ceases to other parts of the plant.

Animal Tissues

Animal tissues organisation is based on active locomotion.

Animal Tissues

it is covering and protective tissue, which are tightly packed. They are present in skin, living of mouth.

1. Squamous 'Epithelium Simple flat kind of epithelium, form a delicate living of skin.
2. Cuboidal 'Epithelium Cube shaped cells have rounded nuclei, forms living of kidney tubules and ducts of salivary glands providing mechanical support.
3. Columnar 'Epithelium Tall, pillarl like cells have elongated nuclei. Usually found in inner lining of intestime, where apsorption and secretion occurs.
4. Ciliated Columnar 'Epithelium Cells have cilia, hair like projections found on the outer surtaces of epithelial cells.
5. Glandular 'Epithelium Epithelium acquire additional specialisation known as gland cells, can secrete substances at the epithelial surtace.

Connective Tissue

They connect various body organs.

1. Fluid or vascular Tissue Links different parts of the body and maintains the continuity of body.
2. Dense Tissue Fibrous connective tissue, consists of densely packed collection of fibres and cells component of tendors and liqaments.
3. Skeletal Tissue Forms endoskeleton of vertebrate body and provides.

Muscular Tissue

Consists of elongated cells and responsible for movment.

1. Straited Muscles Mostly attacked to bones and helps in body movement.
2. Cardiac Muscles Present in heart, shows rhythmic contraction and relaxation throughout life.

Nervous Tissue

These enables body to respond against stimulus.
They transmits timuli from one place to another within body.

INTRODUCTION

- In unicellular organisms a single cell performs all the vital activities for example, digestion, respiration, excretion etc.
- In case of multicellular organisms specialized functions are performed by a different groups of cells possessing a well-developed division of labour to provide highest possible efficiency of particular function. As blood flows for transportation of O_2, CO_2, food, hormones & waste material, muscle cells are involved in movement etc so cells make a group called tissue.

COMPETITION WINDOW

The term tissue was coined by **Bichat**.
Anatomy :- The study of internal structure of any part of an organism with the help of section cutting is called anatomy.
Histology :- The study of tissues with the help of microscope is called histology.

- A tissue is defined as a group of cells with similar structure, organized to do a common function.
- Term tissue was coined by **Bichat.**
- Branch of biology which deals with the study of tissue is called **Histology.**
- In plants and animals tissues are found but these tissues have differences on various aspects which are following.

Comparative study of Plant and Animal Tissue

S.No.	Plant Tissue	Animal Tissue
1	Tissues organisation is towards stationary or fixed habit.	Tissue organisation is towards active locomotion.
2	Most of the plant tissues are dead and supportive.	Most of the animal tissues are living.
3	The growth in plants takes place in certain specific regions where growing tissues are present.	The growth in animals takes place throughout the body.

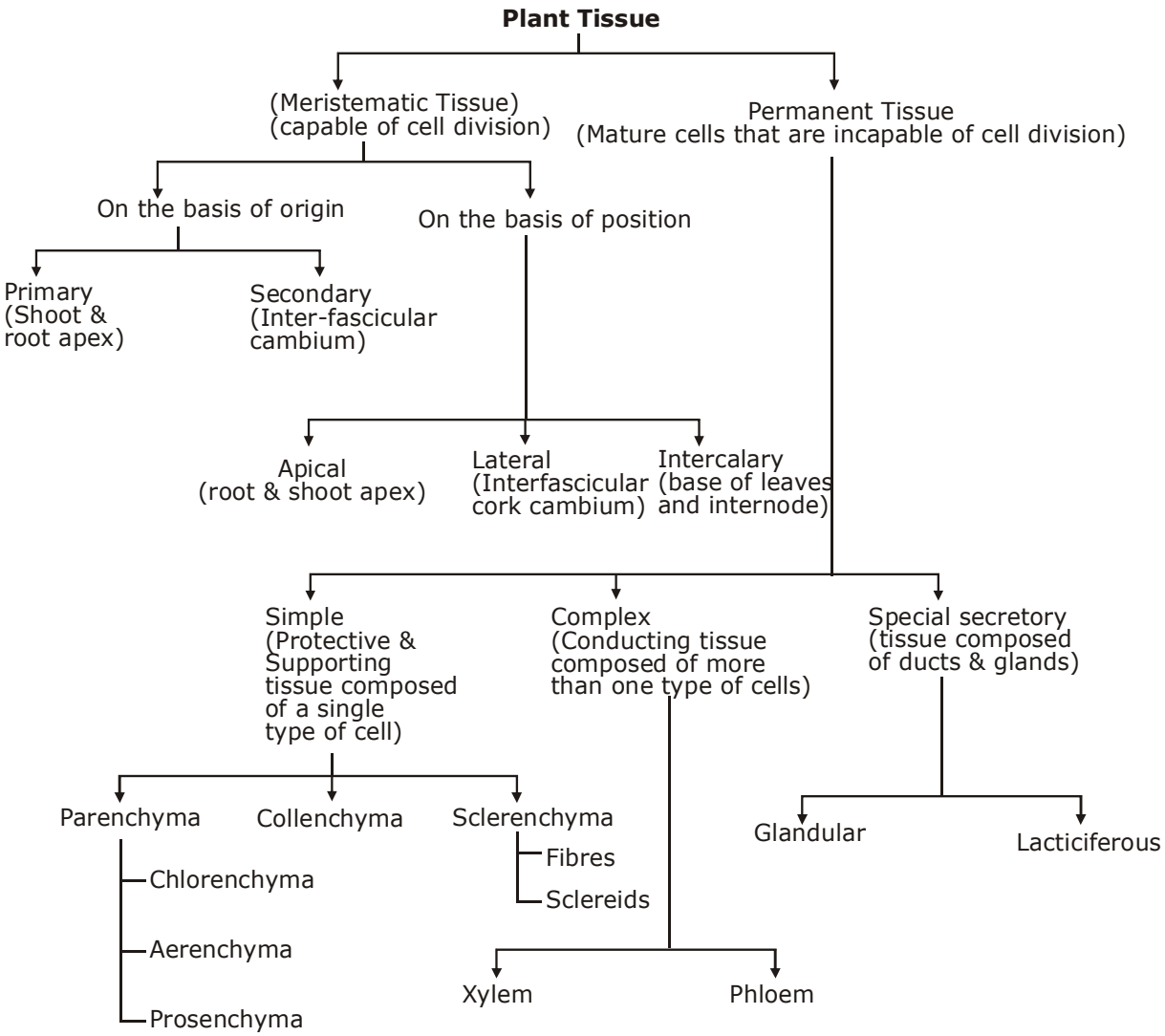
PLANT TISSUE

Plant tissues are of two types on the basis of their dividing capacity :-

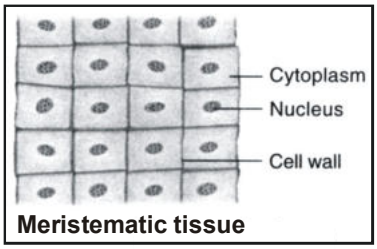
1. Meristematic tissue (growing tissue)

2. Permanent tissue

Comparative study of Meristematic tissue and Permanent tissue		
S.No.	**Meristematic tissue**	**Permanent tissue**
1	The cells are capable of division.	The matured cells are incapable of division.
2	The cells are undifferentiated.	The cells are fully differentiated.
3	The cell wall is thin.	The cell wall is relatively thick.
4	Large prominent nucleus.	Small nucleus.
5	Vacuoles are small or absent.	Large central vacuole is present.
6	Intercellular space is absent.	Intercellular space is present.



1. MERISTEMATIC TISSUE



Meristematic tissue

- These are living tissues which are composed of immature cells that are capable of division throughout life.
- These tissues are found in growing regions of plants.
- Cells have thin cell wall.
- Cells contain dense cytoplasm and do not have vacuoles.
- Cells contain prominent and large nucleus.
- Cells are metabolically highly active, so store food is absent.
- Cells are compactly arranged because they do not have intercellular spaces.

❑ **Function :-** Meristematic tissue is responsible for the growth in length and width(girth) of plant body.

❑ **CLASSIFICATION OF MERISTEMATIC TISSUE**

- **On the basis of origin:**

(a) Pro meristem: It is the first meristem which develop during embryonic stage.

(b) Primary meristem: Derived directly from the meristems of embryo (Promeristem).

- Derived directly from the meristems of embryo (Promeristem).
- They add to primary growth of plants.

(c) Secondary meristem:

- Formed by permanent tissues.
- These are having cells derived from permanent tissue.
- They usually add to the diameter of plants.
- Pemanent tissue $\xrightarrow{\text{Dedifferentiation}}$ Secondary meristem

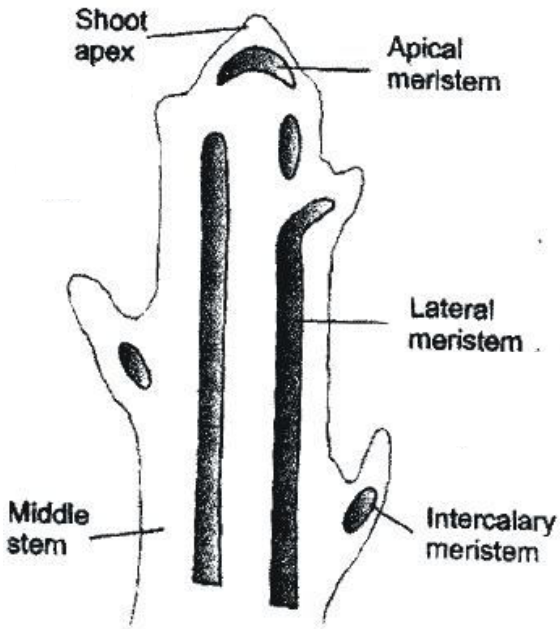
- **On the basis of their location meristematic tissues are of three types.**

(i) Apical meristem : It is present at the growing tips of stems and roots.

- They are responsible for increase in the length of plant organs.

COMPETITION WINDOW

Meristematic tissues are of three types on the basis of origin-
Promeristem :- These are embryonic meristem which give rise to primary meristem.
Primary meristem :- These are always in active state of division and give rise to primary permanent tissue.
Secondary meristem :- These are developed from primary permanent tissue and give rise to secondary permanent tissues.



TYPES OF MERISTEM IN A SHOOT

DO YOU KNOW ?

- Shoot apical meristem is terminal in position.
- Root apical meristem is subterminal in position due to the presence of root cap.
- Apical meristem has two regions at embryonic stage.
  First – Promeristem Second – Eumeristem
- Eumeristem is divided into three regions
  1. Protoderm 2. Procambium 3. Ground meristem
- Apical meristem is absent in Algae and Fungi.
  Apical and intercalary meristem are responsible for primary growth of plant (growth in length).

(ii) Intercalary meristem :

- It is the part of apical meristem which is left behind during growth period.
- They are short lived and convert into permanent tissue.
- These are present at the base of leaf or internode.

- Intercalary meristem may be present either at the node as in grasses, bamboo and mints or the base of ***Pinus*** leaves.
- They are responsible for the growth in length of plant organs.

(iii) Lateral meristem :-

- It lies on the lateral sides of stem and root or occurs along the sides of longitudinal axis of the plant.
- It helps in increasing the diameter (girth or width) of plant.
- Hence helps in secondary growth.

COMPETITION WINDOW

Lateral meristem are both primary and secondary in origin-
Primary lateral meristem e.g. marginal meristem of leaf and Intra fascicular cambium.
Secondary lateral meristem e.g. Inter fascicular cambium and cork cambium.
Lateral meristem is present in only dicot plants.

DIFFERENCES BETWEEN THREE TYPES OF MERISTEMS

S. No.	Characters	Apical meristem	Intercalary meristem	Lateral meristem
1	Position	Shoot apex and root apex	At the base of leaf sheath of monocots e.g. grasses.	Lateral sides of stem and root.
2	Type of growth	Longitudinal growth	Longitudinal growth.	Growth in diameter or girth.

2. PERMANENT TISSUE

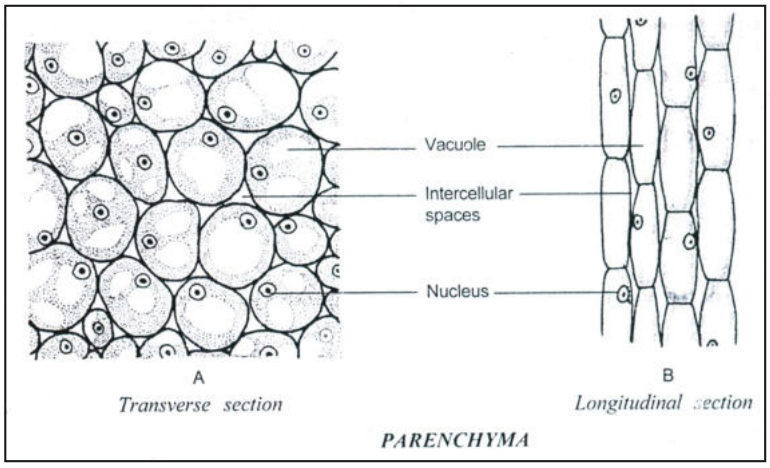
- They are formed by division and differentiation of meristematic tissue.
- They are composed of those cells which have lost the power of division (temporarily or permanent) and attain a permanent shape, size and function.
- Cells may be living or dead.
- Cells may be oval, rounded, polygonal or elongated.
- Permanent tissues are of two types :-
  (a) Simple permanent tissue
  (b) Compound or complex permanent tissue

(a) Simple permanent tissue :- These tissues are made up of similar types of cells, that perform a common function. They are protective and supportive in nature.

- Simple tissues are of three types :
  (i) Parenchyma (ii) Collenchyma (iii) Sclerenchyma

(i) Parenchyma :-

- It is a living and basic packing tissue which consists of relatively unspecialised cells.
- Cells of these tissues have thin cell wall which is made up of cellulose.
- Cells of these tissues have dense cytoplasm with small nucleus and large vacoule.
- They are usually loosely packed because intercellular spaces are present between cells.



❑ **Functions :-**

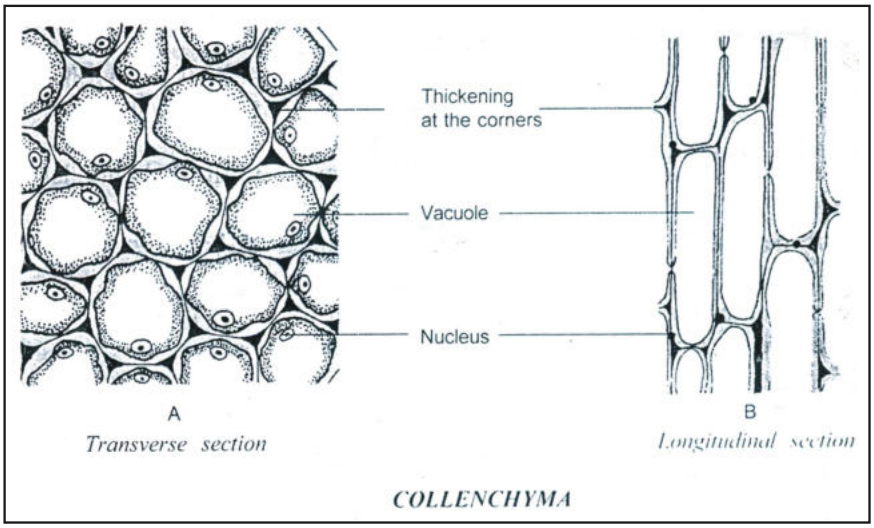
- Storage of food and provide support to the plant.
- Parenchyma is the first evolved permanent tissue which is present in all soft parts of plant (therefore called as universal tissue).
- The body of bryophytes is made up of only parenchyma tissue.
- In dorisventral leaf of dicot plant, two types of parenchyma tissues are present.
  (i) spongy tissue (ii) palisade tissue
- Parenchyma provides targidity to cells.
- **Differentiation :-** The developement process in which cells take up a permanent shape, size and perform a specific function.

❑ **Modification of parenchyma :**

- **Chlorenchyma :-** Such type of parenchyma in which abundant quantity of chloroplasts are found. (contains chloroplasts)
- They are present in mesophyll of leaves.
  Function :- Synthesis of food (Photosynthesis)
- **Aerenchyma :-** Parenchyma is made up of rounded cells which surrounds the large air cavities. It is found in aquatic plants or hydrophytes.
  e.g. petiole of water hyacinth.
- Parenchyma cells which store rasin tanin gum and oil are also so called idioblast.
- **Prosenchyma** :- Parenchymatous cells become long and taper at both the ends.
  e.g. It is found in pericycle of root.
- **Stellate** parenchyma found in the leaf bases of banana, leaf bases performs the function of stem.
  Function :- It provides buoyancy to the aquatic plants to help them float.

(ii) Collenchyma (Flexible tissue) :-

- Cells of this tissue are living, elongated or vary in structure.
- Cells of this tissue are irregularly thickend at the corners due to the deposition of pectin.
- It is present below the epidermis of leaf stalk and leaf margin.
- Intercellular spaces are very little or absent between cells of this tissue.
- Cells of collenchyma contain few chloroplast.



COLLENCHYMA

❑ **Functions :-**

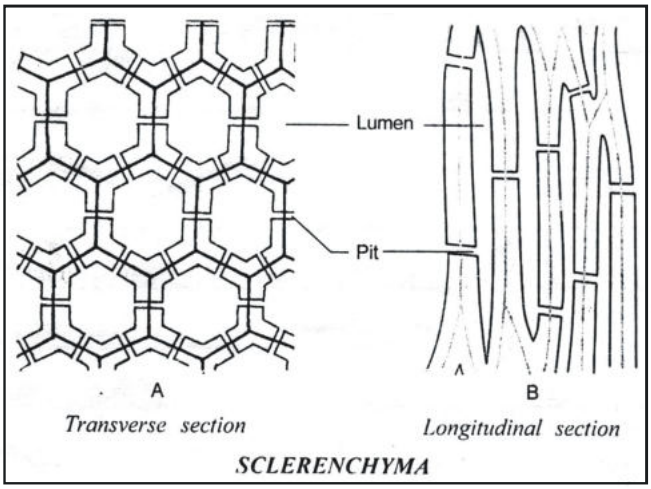
- It provides mechanical support (tensile strength) and elasticity.
- It protects the cracking of lamina margin due to action of wind.
- It provides flexibility to plant.
- It allows easy bending in various parts of plant (leaf and stem) without breaking.

(iii) Sclerenchyma :-

- Sclerencyma cells are dead cells and they are devoid to protoplasm.
- The walls of cells of sclerenchyma are greatly thickened with deposition of lignin. Such cell walls are called lignified.
- The cells of sclerenchyma are closely packed without intercellular spaces.
- They are found in stems (around the vascular bundle), roots, veins of leves, hard coverings of seed and nuts.

❑ **Function :-** It is the main mechanical tissue which provides mechanical support.

- It make the plant hard and stiff.



- Sclerenchymatous cells are of two types in structure:

  1. Fibres 2. Sclereids

1. Sclerenchyma fibres :- They are highly elongated (1 mm to 550 mm in length), narrow and spindle shaped with pointed or oblique end walls.

- The fibres are closely packed without intercellular spaces.

COMPETITION WINDOW

Lignin is a complex polymer which acts as a cement and hardens cell wall. Lignin makes the cell wall impermeable so important substances are unable to pass through it. As a result, cells that are heavily lignified do not have living content (protoplasm).

❑ **Functions :-**

- Sclerenchyma fibres constitute the major mechanical tissue of the plants and are abundantly found in plants. Commercial fibres obtained from plants (e.g. Jute, Flax, Hemp, Husk of coconut etc.) usually are sclerenchymatous fibres.

2. Sclereids (grit or stone cells) :- They are highly thickened and irregularly shaped dead cells.

- They are found in various parts of the plant such as cortex, pith, phloem, hard seeds etc.
- The grit of pulp of some fruits (such as guava, apple, pear etc.) is due to the presence of sclereids in it.

❑ **Functions :-**

- The main function of sclerenchyma is to provide mechanical support to the plants.

  Sclereids provide strength to seed covering and grittiness to the pulp of many fruits.

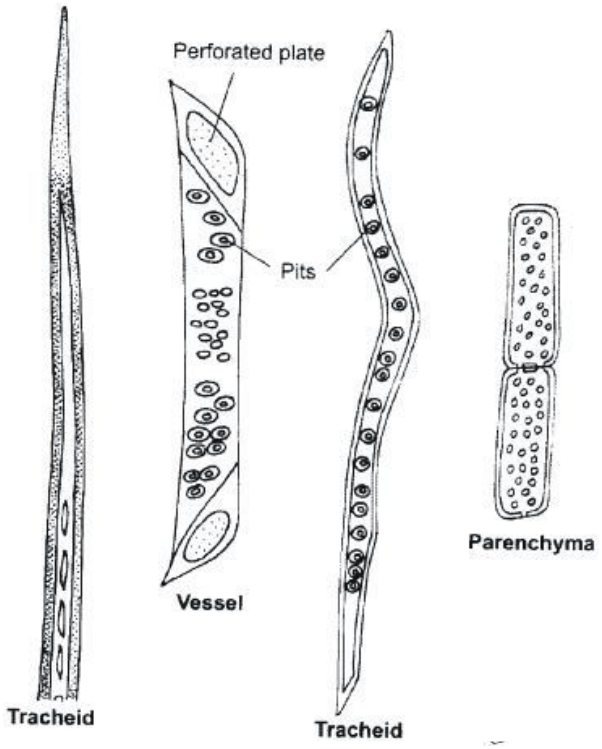
DIFFERENCES BETWEEN FIBRES AND SCLEREIDS		
S. No.	**Fibres**	**Sclereids**
1	They are highly elongated, narrow and spindle shaped cells.	They are spherical or irregularly shaped cells.
2	They occur in bundles.	They occur in loose groups.
3	They provide mechanical strength to the plant parts.	They give hardness to seed coat and grittiness to fruit pulp.
4	They can be spun hence are used for making ropes.	They cannot be spun, hence have no commerical importance.

Comparative study of Parenchyma, Collenchyma and Sclerenchyma			
S.No.	**Parenchyma**	**Collenchyma**	**Sclerenchyma**
1	It consists of living cells.	It consists of living cells.	It consists of dead cells.
2	Intercellular spaces are present.	Intercellular spaces may or may not be present.	Intercellular spaces are absent.
3	Cell wall is thin without having secondary deposition.	Cell wall is thick as it has pectin deposition.	Cell wall is thick as it has lignin deposition.
4	Cells contain cytoplasm.	Cells contain cytoplasm.	Cells are devoid of cytoplasm.
5	Cell wall does not have pits.	Cell wall does not have pits.	Cell wall bears pits.
6	They have vital functions like synthesis and storage of food.	They have both vital as well as mechanical functions, providing support and elasticity to plant body.	It is chiefly a mechanical tissue.

(B) Compound or complex permanent tissue :

The complex tissues consist of more than one type of cells. All these cell co-ordinate to perform a common function. Complex tissues transport water, mineral salts (nutrients) and food material to various parts of plant body. Complex tissues are of the following two types :

(i) Xylem or wood **(ii) Phloem or bast**



XYLEM ELEMENTS

(i) **Xylem :-** Wood

Xylem is made up of four types of cells -

1. Tracheids
2. Tracheae or vessels
3. Xylem fibres

] Dead elements

4. Xylem parenchyma] Living element

1. **Tracheids:** Tracheids are elongated cells with tapering ends. They also conduct water. Since tracheids do not have open ends like the vessels, so the water has to pass from cell to cell via the pits.

2. **Vessels or tracheae :** Very long tube like structures formed by a row of cells placed end to end.

- The transverse walls between the vessels are completely dissolved to form continuous channels or water-pipes.

❑ **Functions :**

- Tracheids and vessels help in long distance conduction of water and minerals upward from the root system to various parts of plant.
- Tracheids and vessels provides mechanical support.

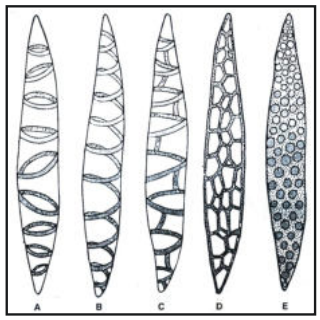
3. **Xylem fibre:** These are dead and lignified sclerenchymatous cells which are mainly supportive in function.

4. **Xylem parenchyma:** It is formed of living parenchymatous cells which helps in storage of food and lateral conduction of water and minerals.

DO YOU KNOW ?

- Xylem and phloem are both conducting tissues and also known as **vascular tissues** (conducting tissue) ; together both of them constitute vascular bundles.
- Vessels and tracheids have 5 type of lignification.

  Annular, spiral, reticulate, scalariform and pitted.



A. Annular; B. Spiral; C. Scalariform; D. Reticulate. E. Pitted.

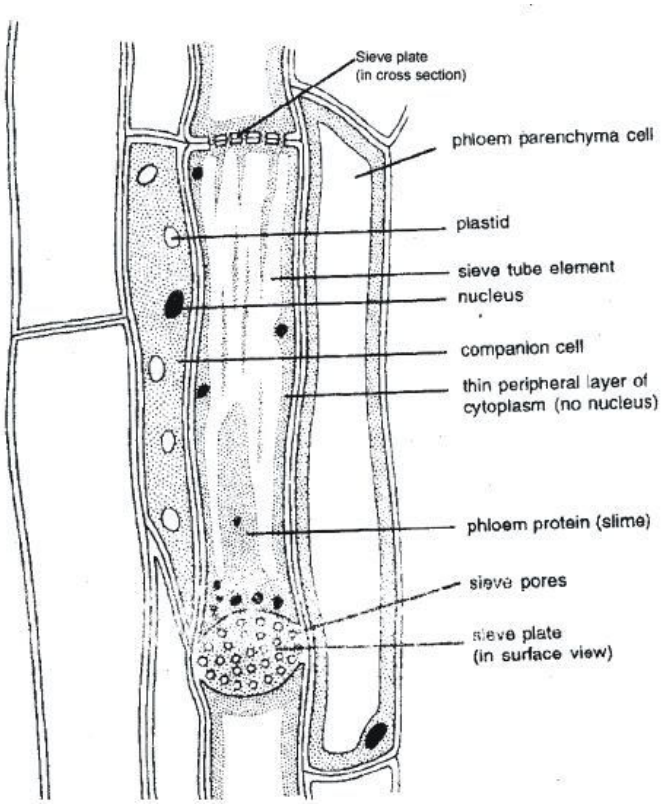
- Vessels are only found in xylem of angiosperm but exceptionally present in gymnosperm ***(Ephedra, Gnetum and Welwitschia)***
- Vessels are example of dead syncyte.
- **Pit formations :** No lignin is laid down where plasmodesmata were present in the original cell walls. These non-lignified areas are known as pits and they allow water to pass sideways betwen one xylem vessel and the next.
- As vessels and tracheids of xylem have the lignified cell walls, so this simply mean that these cells are hollow and there are no cell contents to restrict the flow of water.

- **Hadrome :** Tracheids & vessels are collectively called as hadrome and the hadrome as main conducting elements in xylem.
- The annual rings present in the trunk of a tree are xylem rings. By counting the number of annual rings we can determine the age of a tree (Dendrocronology).

(ii) Phloem : It is also made up of four types of cells

1. Sieve tubes
2. Companion cells — living elements
3. Phloem parenchyma

4. Phloem fibres — dead element



PHLOEM

1. **Sieve tubes :** Sieve tubes are slender, tube-like structures composed of elongated thin-walled cells, placed end to end.

- Their end walls are perforated by numerous pores and are called sieve plates. Walls of sieve tubes are perforated.
- The nucleus of each sieve cell degenerates at maturity, however, cytoplasm persists in the mature cell.
- Thus, nuclei are absent in mature sieve tube elements.
- The cytoplasm of one sieve tube element is continuous with those of the sieve elements above and below by cytoplasmic connections passing through the pores of the sieve plate.

COMPETITION WINDOW

Although sieve tube elements do not have nuclei, but they still remain living. It is so because they are dependent on adjacent companion cells which develop from the same original meristematic cell. The two cells together for a functional unit.
Leptome : Main part of phloem involved in conduction of food, which is sieve tube. companion cells are present only in phloem of angiospermic plants.

2. **Companion cells :** These are associated with sieve tubes.

- These are smaller cells having dense cytoplasm and prominent nucleus.
- The companion cells help the sieve tubes in the conduction of food material.
- Sieve cells & companion cells are so called sister cell because they originate from single mother cell.

3. Phloem parenchyma :

- These are living and thin walled cells.
- It is also known as bast parenchyma.
- It helps in conduction of food in radial direction.
- It store various materials **e.g.** Resin, Latex, Mucilage.

4. Phloem fibres : These are dead and sclerenchymatous cells. Phloem or bast fibres of some plants are ource of commercial fibres e.g. Jute, Hemp, Flex.

- They provide mechanical support to the conducting elements.

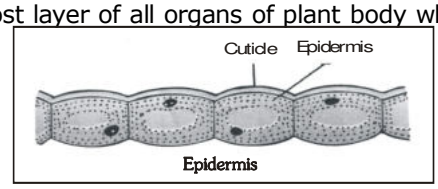
❑ **Function of phloem** : Phloem transport photosynthetically prepared food materials from the leaves to the storage organs and latter from storage organs to the growing regions of the plant body.

Differences between xylem and phloem		
S.No.	Xylem	Phloem
1	It is composed of vessels, tracheids, xylem parenchyma and xylem sclerenchyma.	It is composed of sieve tubes, companion cells, phloem parenchyma and phloem sclerenchyma.
2	It conducts water and minerals from roots to leaves.	It translocates food from leaves to different parts of the plant.
3	Xylem parenchyma are the living cell in xylem.	Sieve tubes, companion cell and phloem parenchyma are the living cells in phloem.
4	Xylem also provide mechanical strength to the plant.	It does not provide mechanical strength to the plant.

PROTECTIVE TISSUE : These tissues are primarily protective in function. They are of two types :

(1) Epidermis **(2) Cork**

1. Epidermis : It is the outermost layer of all organs of plant body which is formed from parenchymal cells.

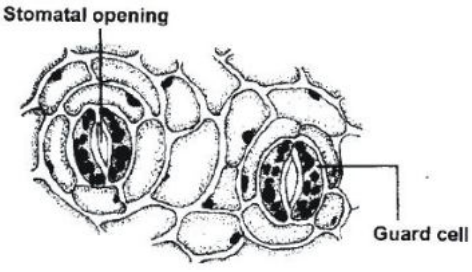


- It protects the internal tissue from mechanical injuries and entry of germs.

❑ **Cuticle :** The outer wall of epidermis of aerial parts of plant secretes and diposits a waxy substance, called cutin which form a water proof layer called cuticle.

- It checks the loss of water by transpiration.
- Lower epidermis of dicot leaves have large number of microscopic aperture called stomata.

❑ **Stomata** : Each stomata is an elliptical aperture bounded by two kidney shaped guard cells which regulate opening and closing stomata.



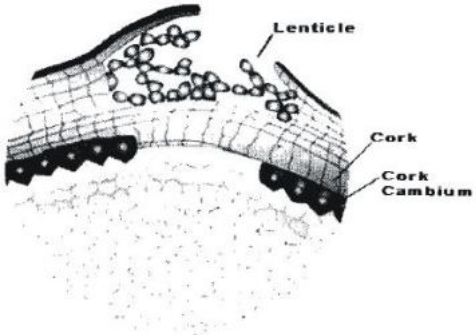
STOMATA

- Guard cells are kidney shaped in dicot and dumb-bell shaped in monocot.
- Stomata helps in exchange of gases.
- It helps in loss of water vapours called transpiration, develops a force called transpiration pull,which helps in absorbtion of water by the roots.

❑ **Root hairs :** Epidermis of roots (epiblema) have root hairs which greatly increase their surface area for absorption of water and minerals.

2. Cork or Phellem :

- Cork is the peripheral tissue of old stems and roots of woody trees and is formed due to activity of cork cambium or phellogen (secondary lateral meristem).



T.S. OF CORK PIECE SHOWING CORK CELLS

- Cork cambium produces off new cell on its both sides, thus, forming cork (phellem) on the outer side and the **secondary cortex** or **phelloderm** on the inner side.
- It is made up of dead cells with thick wall but no intercellular spaces.
- The walls of cork cells are heavily thickened by the deposition of an organic substance (a fatty substance), called suberin. Suberin makes these cell impermeable to water and gases and it also helps in conservation of water in the trees.

❑ **COMMERCIAL IMPORTANCE OF CORK :**

- Cork is light and highly compressible which does not catch fire easily.
- Cork is used in the making of a variety of sports goods such as cricket balls, table tennis, shuttle-cocks, wooden paddles etc.

❑ **Functions :**

- Cork is protective in function.
- Cork prevents desiccation (by preventing loss of water from plant.)
- Cork prevents infection and mechanical injury.
- Lenticels (pores) present in the cork provide aeration to the inner tissues.

COMPETITION WINDOW

Dedifferentiation. In this process the specialized cells regain the division power and become meristematic e.g. **vascular cambium.**

The cork cells do not contain protoplasm but are filled with resin or tannins. In case of onion bulb too, in the skin of onion the cell walls become thick and water proof due to addition of suberin.

Cork and bark are not the same structures. While cork includes outer products of cork cambium, the bark includes the outer products of cambium such as secondary phloem and also cork cambium and cork.

Commercial cork is obtained from the stem surface of ***Quercus suber.***

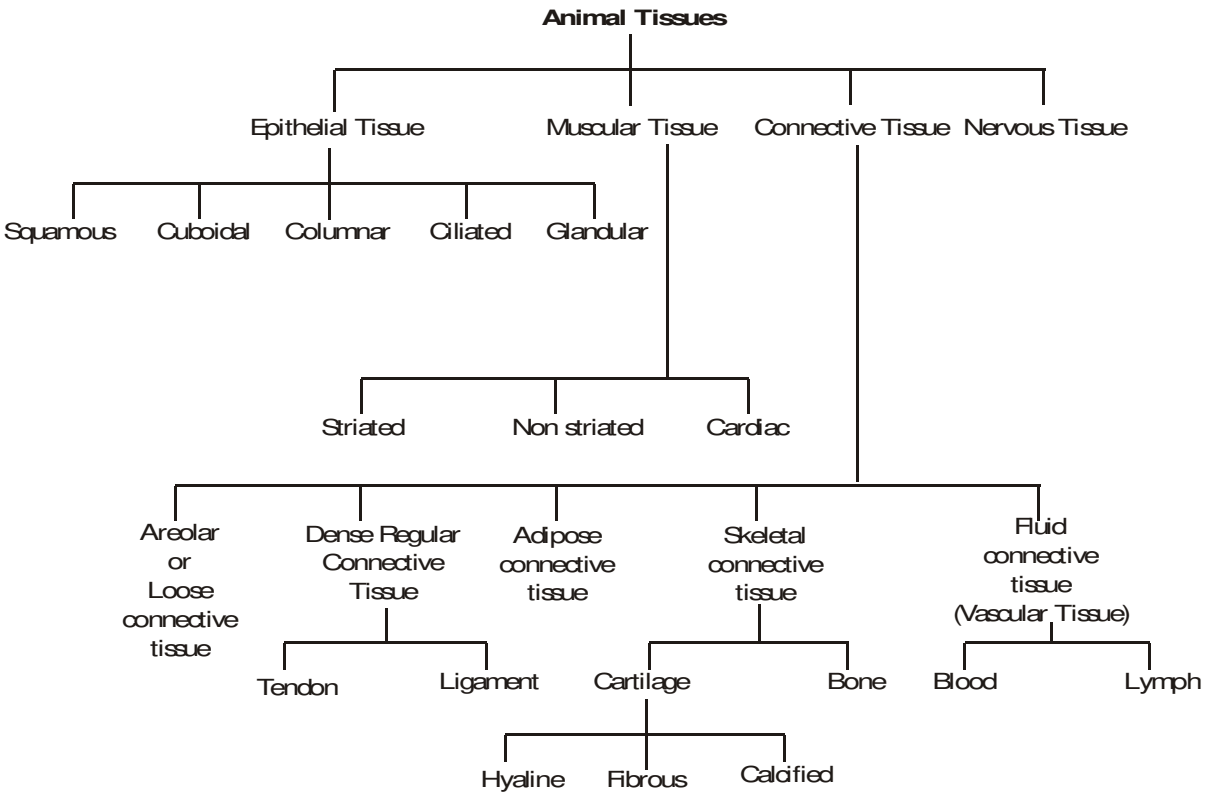
ANIMAL TISSUE

The living organisms are either unicellular [eg. – Bacteria, Diatoms, Yeasts, Potozoans] or multicellular [eg. Man, Lion , Dog]. Each unicellular organism is able to perform all their vital activities like digestion, respiration, excretion, reproduction.

Utility of tissues in multicellular organisms :-

With the increasing degree of multicellularity in living beings, it became difficult for each cell to efficiently perform all the physiological functions of the body. Hence, nature assigned specialized function to different group of cells called **tissues**. Thus, the utility of tissues in multicellular organisms is to perform specific functions of the body.

- **Bichat** introduced the term **'tissue'**.
- **Mayer** introduced the term **'Histology'**. [Study of tissue is called histology]
- **Marcello Malpighi** is the **'Founder of Histology'**.
- The term **'epithelium'** was introduced by **Ruysch**.



Types of animal tissue : Based on the location and function, the animal tissue are classified into four types-

S.No.	Type	Origin	Function
1	Epithelial tissue	Ectoderm, Endoderm, Mesoderm	Protection, Secretion, Absorption etc.
2	Connective tissue	Mesoderm	Support, binding, storage protection, circulation
3	Muscular tissue	Mesoderm	Locomotion and movement
4	Nervous tissue	Ectoderm	Control, coordination and conduction of impulse

EPITHELIAL TISSUE

Word epithelium is composed of two words **Epi**-upon, **Thelio**-grows. (Means - A tissue which grows upon another tissue is called epithelium).

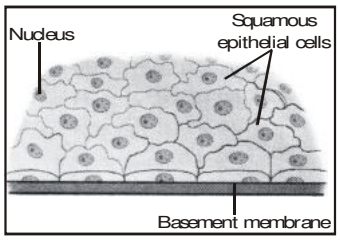
Nature:

- It is the simplest tissue. It is the protective tissue of animal's body.
- It covers most organs and cavities within the body.
- It also form a barrier to keep different body systems separate.
- Epithelium cells are closely packed, so there is **very little inter-cellular spaces** are present between the cells. Due to absence or less of intercellular spaces blood vessels, lymph vessels and capallaries are unable to pierce this tissue, so blood circulation is absent in epithelium. Hence cells depend for their nutrients up on the underlying connective tissue.
- It always rest upon underlying connective tissue.
- At the junction of the (Epithelial tissue and connective tissue) layer is present which is called of basement membrane, which is formed of mucopolysaccharides and collagen fibrils.
- Epithelial tissue has great regeneration power because meristematic cells can divide to replace old and dead cells.

The skin & lining of buccal cavity, blood vessels, alveoli (of lungs) and kidney tubules are made of epithelial tissue.

The tissue which evolved first in animal kingdom and appears first during embryological developement is the epithelial tissue.

Types of epithelial tissues :- (Depending upon the shape & function of the cells)

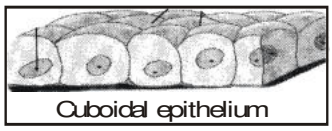


Squamous : Types of epithelial tissure on the basis of shapes and functions

Type : Squamous

Description : Flattened cells, extremely thin.

Common locations : Blood vessel walls, air sacs of lungs, oesophagus, lining of mouth.

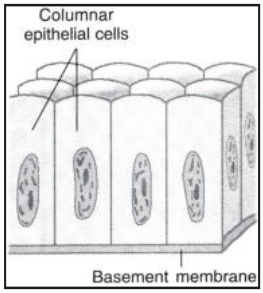


Funtion : Diffusion

Type : Cuboidal

Description : cubelike cells, may have microvilli at its free surface

Common location : Part of gut lining, lining of kidney tubules, ducts of salivary glands.

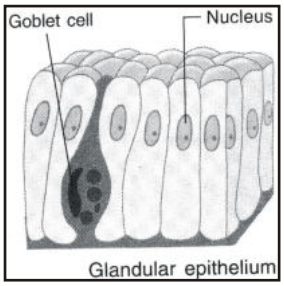


Function : Secretion, absorption, mechanical support.

Type : Columnar (Pillar like)

Description : tall slender cells ; may have microvilli at its free surface.

Common locations : Inner of intestine, part of respiratory tract linning.



Function : Secretion, absorption.

Modification of columnar epithelium

Type : Glandular epithelium

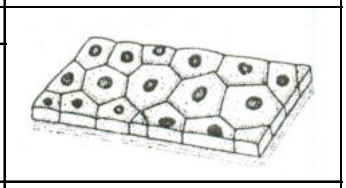
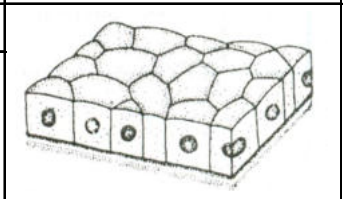
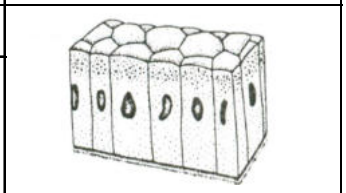
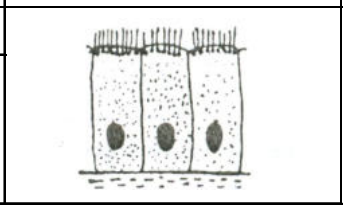
Description : Tall, slender cells, some cells from the free surface invaginate inside to form secretory cells- goblet cells.

Common location : Lining of intestine & glands

Function : Secretion of mucus and other secretions.

Pseudostratified Epithelium :-

Some times columnar epithelium has cells of different sizes. Besides column like tall cells, some cells are small called **basal cells** which do not reach upto the margin. Due to different size of cells nuclei appear to be present in more than one layers. Although it is single layer of cells but it appears to be multilayered and is called pseudostratified epithelium. It occurs in the lining of trachea, bronchi, vas deferens, urethra, epididymis and pharynx.

Structure	Location	Function	Diagram
Simple Squamous			
Single layer of flatened & polygonal cells, large centrally located nucleus.	Alveoli, blood vessel heart wall	Filtration, absorption and secretion	
Simple cuboidal			
Single layer of cube-shaped cells, centrally located nucleus	Testes, Ovary, kidney tubules, salivary duct and pancreatic ducts	Excretion, Secretion and absorption	
Simple columnar (Nonciliated)			
Single layer of pillar shaped cells.	Lining of stomach, small and large intestine, digestive glands and gall bladder	Secretion and absorption	
Simple Columnar (Ciliated)			
Single layer of ciliated rectangular Pillar shaped cells	Oviduct, Vas deferens, few portions of upper respiratory tract.	Movement of gametes, and mucus by ciliary action	

Connective tissue

The cells of connective tissue are loosely spaced and embedded into a non cellular matrix. The matrix may be solid (as in bone), soft (as in loose connective tissue), or liquid (as in blood)

General Functions of connective tissue :

(i) **Storage** – Certain connective tissue like adipose tissue store fats.

(ii) **Supports** – Skeletal connective tissue like bones and cartilage provide the body with a supporting skeletal framework.

(iii) **Transport** – Fluid connective tissues such as blood and lymph transport various material in the body.

(iv) **Defence and scavenging** – Plasma cells synthesize antibodies, macrophages, lymphocytes, which ingest foreign matter and harmful bacteria.

(v) **Shock absorber** – The jelly like ground substances of connective tissue acts as shock absorber around some organs like eyeballs and kidney.

(vi) **Formation of blood corpuscles** – The bone marrow produces blood cells.

(vii) **Packing material :** Areolar tissue act as packing material in various organs.

(viii) **Repair** – Collagen fibre of connective tissue help in repairing of injured tissues.

TYPES OF CONNECTIVE TISSUE

(a) Areolar [loose] connective tissue.

(b) Dense regular connective tissue.

(c) Adipose tissue

(d) Skeletal tissue

(e) Fluid connective tissue.

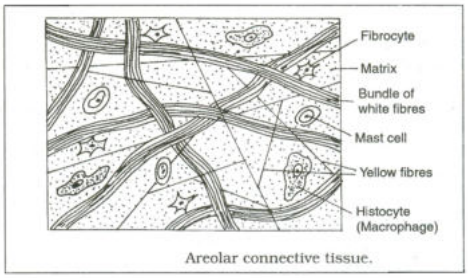
(a) Areolar [loose] connective tissue :

Nature : It is a loose and cellular connective tissue. It is the most abundant of all types of connective tissues. It has large amount of matrix. Its matrix consists of two kinds of fibres –

(i) White collagen fibres

(ii) Yellow elastic fibres or elastin.

Occurrence :- It is simplest & most widely distributed connective tissue. It joins skin to muscles, fills spaces inside organs and is found around muscles, bone marrow, blood vessels & nerves.



Areolar connective tissue.

Functions :

(i) It acts as a supporting & packing tissue between organs lying in the body cavity.

(ii) It helps in repair of tissues after an injury.

(iii) It also helps in combating foreign toxins.

(iv) It fixes skin to underlying muscles.

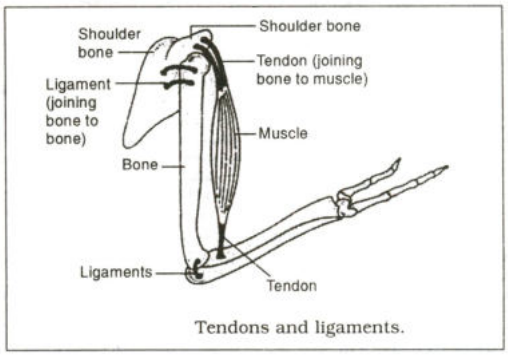
(v) It provides rapid diffusion of oxygen and nutrients from blood vessels.

(b) Dense regular connective tissue :

It is a fibrous connective tissue which is characterized by systematically and densely packed fibres and cells.

Dense regular connective tissue is the principal component of tendons & ligaments.

(i) **Tendons:** These are **cord like, strong, inelastic, structures that join skeletal muscles to bones**. It has great strength but its flexibility is limited. It is made up by collagen fibres.



Tendons and ligaments.

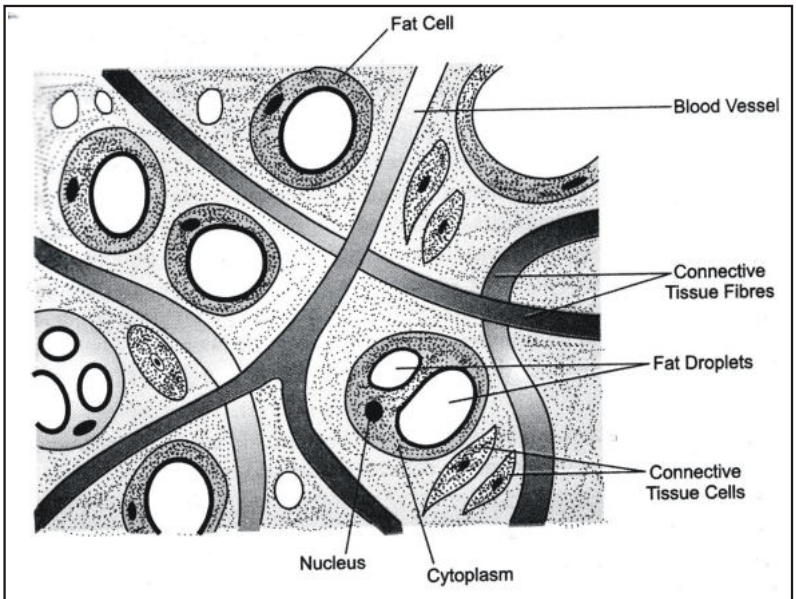
(ii) **Ligaments:** They are elastic structures which connect bones to bones. It is highly elastic and has great strength but contains very little matrix. It is made up of both collagen and elastin fibres.

Ligaments strengthen the joints of body and they permit normal movement but prevent over flexing or over-extension. **Sprain** is caused by excessive pulling [stretching] of ligaments.

Characters	Tendons	Ligaments
(i) Nature	Tough and non-elastic	Strong and elastic
(ii) Structure	Made up of white collagen fibrous tissues.	Made up of yellow fibrous tissue and white collagen fibrous tissue
(iii) Arrangement of fibroblasts	Present in rows between fibres	Scattered in matrix in between the bundles of white fibres.
(iv) Function	Join muscle to bone	Join bone to bone

(c) **Adipose tissue :** It consists of large number of oval and rounded adipose cells [Adipocytes] filled with fat globules.

Adipose cells may contain single large fat droplet [white adipose tissue] or several tiny droplets [Brown adipose tissue] Besides adipocytes, adipose tissue also contains fibroblasts, macrophages, collagen and elastic fibres.



Adipose Tissue

COMPETITION WINDOW

Adipose tissue occurs in different parts of body and forms about 15% of our body weight. It forms cushions around kidney and heart and it also occurs in yellow bone marrow. It mainly occurs as subcutaneous fat layer under skin called **penniculus adiposus**. In whale and elephant **blubber** is a thick adipose layer. Hump of camel, thick tail of marino sheep and fat bodies of frog represent adipose tissue. It is very important component of skin in mammals living in polar regions.

Adipose tissue is fat depot in the body. It stores fat and releases it for energy production, whenever needed in the body.

Stored fat is generally of two types :- white (or yellow) fat and **brown fat.** Generally white fat occurs in the body.

Functions :-

(i) Adipose tissue acts as food reservoir by storing fat.

(ii) This tissue is found below the skin, between internal organs and in the yellow bone marrow.

(iii) It acts as an insulator and regulates body temperature.

(iv) Animals living in cold climates have a lot of this tissue to protect them from the cold.

(d) Skeletal tissue :

Skeletal tissue forms the rigid skeleton which supports the vertebrate body, helps in locomotion and provides protection to many vital organs. It is mesodermal in origin. There are two types of skeletal tissues :-

(i) Cartilage (ii) Bone.

Cartilage :

Cartilage is a special type of connective tissue which forms the soft endoskeleton of the body. It consists of extensive ground substance or matrix called **chondrin**. Matrix is composed of proteins and sugars and because of the presence of calcium salts becomes slightly hardened. It also contains network of white collagen fibres and yellow elastic fibres. Nerves and blood vessels do not penetrate into chondrin.

- The cartilage cells called chondrocytes are present in groups of 2, 3 or 4 in fluid filled cavities called **lacunae.**

Types of cartilages :-

On the basis of composition of matrix, amount and nature of fibres cartilages are of four types :-

(i) Hyaline cartilage (ii) White fibrous cartilage

(iii) Yellow elastic cartilage. (iv) Calcified cartilage.

Occurrence :- This tissue occurs in very few parts of the body. In humans, the cartilage occurs **at the ends of long bones, the pinnae of ears, the ends of nose, in the walls of respiratory ducts,** etc. In sharks and rays, the entire skeleton is cartilage.

Functions :-

1. Cartilage provides support and flexibility to the body parts.
2. It smoothens bone surfaces at joints.

Bone :

Bone is hardest tissue of the body. It forms endoskeleton to give firm support to the muscles. Like other connective tissues, it consists of intercellular material **(matrix)** and cells **(Osteocytes)**. The matrix is composed of about 30% organic materials **(Ossein protein)** and about 70% inorganic materials **(Mainly phosphates and carbonates of calcium and magnesium)**. These inorganic salts are responsible for hardness of the bone.

The matrix of bone is arranged in the form of thin concentric rings called **lamellae**.

In between the lamellae, the bone cells (osteoblasts) are present in fluid filled cavities called **lacunae**, which have fine extensions called **canaliculi**.

In long bones of mammals, the lamellae are arranged around a haversian canal. The Haversian canal contains blood vessels, nerves and lymphatic canals. Haversian canals along with concentric rings of lacunae and osteocytes is called **Haversian system**. Its function is transportation of nutrients and oxygen.

Functions :-

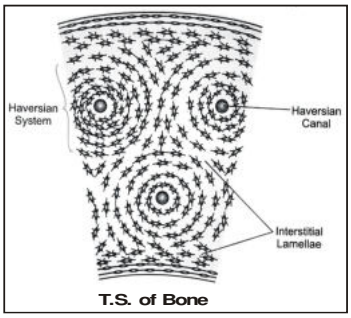
(i) Bones form hard endoskeleton which give shape and support to the body.

(ii) Bones protect vital organs of the body, such as brain, spinal cord, lungs, etc.

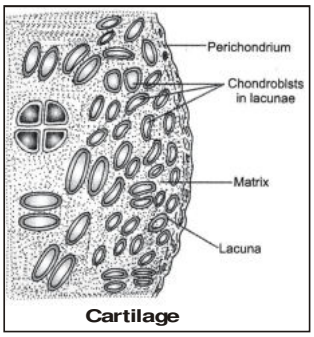
(iii) Bones provide skeletal support to the body.

(iv) Bone marrow is the **centre of blood cell formation in vertebrates.**

(v) Bone attaches the muscles.



T.S. of Bone



Cartilage

	Cartilage	Bone
1.	It is a semi-rigid and flexible tissues	It is strong and non-flexible tissues
2.	A cartilage does not have haversian canal systems	A long bone has a number of Haversion canal systems
3.	Blood vessels are absent	Blood vessels are present
4.	Matrix not arranged in lamellae	Matrix arranged in lamellae
5.	Bone marrow absent. Cartilage always solid	Long bones contain bone marrow in hollow and narrow cavity
6.	Growth of cartilage is unidirectional	Growth of bone is bidirectional
7.	Protein found in matrix is called chondrin	Protein found in matrix is called ossein.
8.	Cartilage forming cells are chondroblasts	Bone forming cells are osteoblasts.
9.	Cartilage cells are chondrocytes	Bone cells are osteocytes.
10.	One lacuna may contain one to four chondrocytes	Only single oesteocyte occurs in one lacuna
11.	Lacunae are without canaliculae	Canaliculae occur in lacunae to accommodate processes of osteocytes.
12.	Capacity to divide occurs in chondrocytes.	Osteocytes do not divide
13.	Matrix may contain only few inorganic salts.	Salts mainly Ca, Mg are heavily deposited
14.	Erythropoiesis (formation of RBC) does not occur.	Erythropoiesis occurs in bone marrow.

IMPORTANT POINTS FOR COMPETITIVE EXAMS

- The most abundant tissue in animal body is the connective tissue.
- The tissue which has minimum intercellular space is epithelial tissue and connective tissue has largest intercellular spaces.
- The epithelial tissue has great regeneration power and it is the first evolved tissue.
- Blubber of whale, hump of camel and thick tail of marino sheep mainly contain adipose tissue.
- The abnormality characterised by gradual softening and bending of bones caused by failure of calcification due to lack of vitamin D is called **osteomalacia** (Gr. osteon = bone, malakia = softness)
- The most abundant protein of the body is collagen, it accounts for about 40% of the total proteins. Wrinkling in old age is due to diminishing rigidity in collagen fibres.
- **Decalcification :-** If a bone is kept in dilute acid like HCl, inorganic salts dissolves in acid and release CO_2, while organic or protein part is left behind. Bone now becomes elastic and soft. This is called decalcification. In KOH solution muscles and connective tissue dissolve, but bone remains unaffected and it becomes clean. When a bone is burnt organic part (protein) burns and the remaining ash contains inorganic salts.
- **Dried bone :-** When bone is exposed to high temperature it becomes dry. All cavities dry up and are emptied.

(e) Fluid Connective Tissue

It is a special type of connective tissue which maintains link among different parts of the body. It receives materials from certain parts of the body and transports them to the other parts.

It constitutes the transport system of animals.

It consists of two basic components – blood and lymph.

Blood

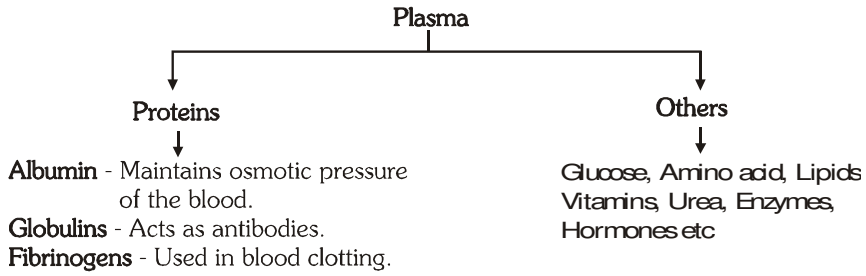
Blood is a mobile connective tissue. It measures about 5–5.5 litres in an adult human being. It is slightly alkaline with a pH value of 7.4.

It consists of an aquous (watery) mixture of substances in solution **(blood plasma)** in which are suspended different types of free floating cells **(blood corpuscles)**.

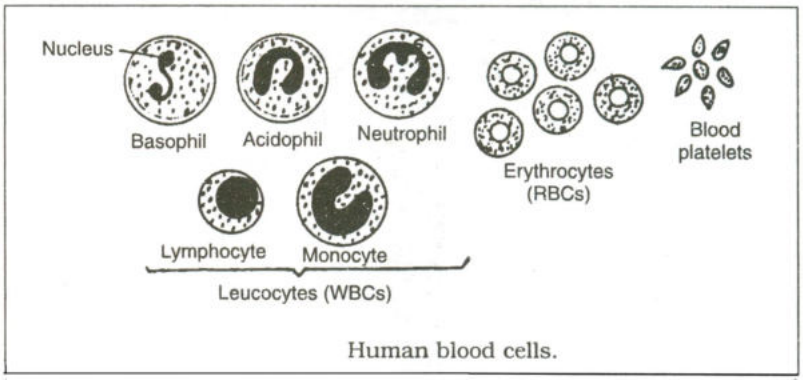
Plasma constitutes about 55% of blood volume while corpuscles constitute 45%.

◈ **Blood Plasma**

It is a pale straw-coloured fluid matrix or medium consisting of about 90% water and 10% mixture of different types of molecules that enter the blood at various locations. These substances include – proteins (soluble proteins such as albumins, globulins and fibrinogen), glucose, amino acids, lipids, vitamins, urea, uric acids, enzymes and hormones.



Blood corpuscles – (i) Red Blood Corpuscles (RBC) or Erythrocytes
(ii) White Blood Corpuscles (WBC) or Leucocytes
(iii) Platelets or Thrombocytes



Human blood cells.

◈ **RBC :-**

(i) **In mammals, RBCs are small, circular, biconcave & discs shaped and lack nuclei when mature.**

(ii) There are about five million red blood cells per mm^3 of blood.

(iii) Their most important character is the presence of an iron protein, **haemoglobin**. The presence of haemoglobin gives the blood its red colour.

(iv) They are manufactured in bone marrow. Their lifespan in human beings is about 120 days, after which they are destroyed in liver.

The RBCs constitute about 99% of blood corpuscles. **Erythrocytes occur only in vertebrate blood and red colour of blood is due to erythrocytes**.

Smallest RBCs occur in musk deer (Tragulus). During maturation, cell organelles of RBC like **nucleus, mitochondria, Golgi body and centrosome become disappear.** Hence surface area of mature RBC increases. It can accommodate more haemoglobin and can carry more O_2.

◈ **WBC**

(i) These are rounded or amoeboid, nucleated, colourless cells.

(ii) WBCs are formed in red bone marrow, spleen, thymus and lymph nodes.

(iii) They are capable of **amoeboid movement** and play an important role in the body's defence mechanism.

(iv) The white blood corpuslces belong to two main categories – **Phagocytes** (carry out the function of body defence by engulfing pathogen) and **Immunocytes** (they are responsible for immunity and carry out immune responses by producing antibodies).

Phagocytes are further divided into two types :- **Granulocytes** (having cytoplasmic granules) and **Agranulocytes** (having non-granular cytoplasm)

Granulocytes :- On the basis of staining these are of three types :-

(a) Eosinophils (stained with acidic dyes)

(b) Basophils (stained with basic dyes)

(c) Neutrophils (stained with neutral dyes).

Agranulocytes :- It includes Monocytes and Lymphocytes.

Functions of blood :

(i) It transports nutrients, hormones and vitamins to the tissues and carries excretory products from the tissues to the excretory organs.

(ii) The RBC's of blood helps in the transport of respiratory gases, oxygen & CO_2.

(iii) The WBCs fight with diseases by producing antibodies and engulfing the germs.

(iv) Blood platelets helps in the clotting of blood.

(v) Blood helps in thermoregulation, water balance and maintenance of pH of body.

◈ **Lymph :-** Lymph is actually filtered blood which is similar to blood in composition except that it is **devoid of RBC, platelets and some blood protein**. WBC are present in abundance in lymph. Due to the absence of haemoglobin, lymph is colourless.

Functions of Lymph :-

(i) Helps in the transport of nutrients. Nutrients that filter out from blood capillaries into lymph are transported back by lymph into blood through heart.

(ii) Helps in the transportation of fat absorbed from intestine to the venous blood.

(iii) Keeps the tissues and organs of the body moist.

(iv) Lymphatic organs (lymph nodes, spleen) produce lymphocytes which in turn produce antibodies to strengthen the immune system of the body.

Q. Distinguish between the following :

(a) Cartilage and bone on the basis of matrix.

(b) Blood and lymph on the basis of components.

Ans. (a) Matrix of cartilage may or may not have calcium salts whereas calcium salts, mainly calcium phosphates, are allways present in the matrix of bone.

(b) Blood consists of plasma, erythrocytes, leucocytes and platelets whereas lymph consists of plasma and leucocytes.

Q. What will happen if stratified squamous epithelium lines the alveoli of lungs ?

Ans. The permeability of alveoli of lungs will be affected so that it will not be able to perform the function of absorption and transportation of substance and selective permeability of alveoli wall will be affected..

POINTS TO BE REMEMBER

- **Clotting** – Process by which the blood solidify and prevent haemorrhage.
- **Antigen** – A foreign substance or toxin which when introduced in to the body of an organism stimulates the production of a specific antibody.
- **Antibody** – A plasma protein [Gamma globulin] produced by an organism to counteract an antigen in the tissue or blood.
- **Glands** – A group of cells which produces and secretes special chemicals.
- **Infection –** Invasion of the body by a pathogen.
- **Matrix** – The basic ground substance in which cells of a tissue are embedded.
- **Monocyte** – A granular leucocyte with a large nucleus. It escapes from the blood by amoeboid movement through the capillary wall and in the tissue is transformed into either macrophages or histiocyte.
- **Fibroblast** – Cells of connective tissue responsible for secretion of fibres.
- Blood flows to all parts of the animal body and thus connects different parts of the body with one another.
- **Lymphocytes :-** They secrete antibodies to destroy microbes and also help in healing of injuries.

MUSCLE TISSUES

Muscular tissue is distinguished from other tissues by its unique ability to contract & relax and thereby perform mechanical work. It is responsible for movement of body organs and locomotion of body.

General structure :-

The structural unit of muscle tissue is the muscle cells which because of its elongated shape is also called muscle fibre.

The contractility is due to the presence of contractile proteins (Actin & Myosin) in the muscle fibre.

The plasma membrane of muscle cells is called **sarcolemma** and endoplasmic reticulum of muscle cell is called **sarcoplasmic reticulum**.

General functions of muscular tissue :-

- It supports the bones and other organs of the body.
- Muscles cause peristalsis of gut, heart beat, production of sound, etc.
- Muscles cause movements of body parts and locomotion of the animals.
- Facial expression also depends on muscles.
- Contraction of muscles causes delivery of a baby.

(A) Unstriated muscle (Smooth muscle) :-

Characteristics :-

These are called smooth or unstriated muscles because they do not show any stripes of striations across the muscle fibres. Each cell (or fibre) is long, narrow spindle shaped with pointed ends and has only one nucleus **(uninucleate)** situated in the centre. These fibres are generally shorter than the striated muscle fibres.

Place of occurrence :- Unstriped muscles are found in the wall of alimentary canal (stomach and intestine), urinary bladder, blood vessels, lungs, etc.

Functions :-

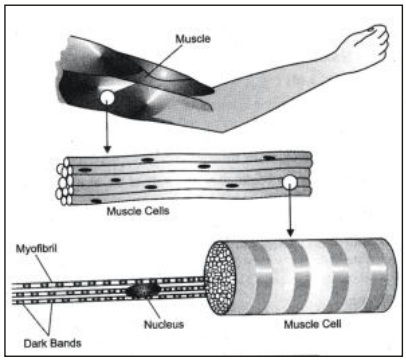
These muscles cause **slow and prolonged contraction** which is involuntary, i.e., not under the control of individual's will. These are under the control of autonomous nervous system. These muscles help in peristalsis of alimentary canal, urinary tract, blood vessels, etc., and contraction of other visceral organs (not heart).

(B) Striated muscle or Skeletal muscle :-

Charcteristics :-

The striated muscles form more than 80% of the mass of soft tissues in a vertebrate body. They are attached to the bones by tendons and help in the movement of external body parts. Therefore, they are also called **skeletal muscles**. The contraction and relaxation of these muscles are under the control of the animal's will. They are, therefore, also called the **voluntary muscles**. The muscle fibres show alternate dark and light stripes (striations or bands), hence they are called **striated muscles**.

The striated muscle consists of long, narrow, cylindrical, unbranched fibres (cells) with blunt ends (non-tapering ends). Each fibre is enclosed in a thin but distinct plasma membrane, called **sarcolemma**. The cell contains many elongated, flattened nuclei characteristically located towards the periphery near the sarcolemma. **The multinucleate condition of the fibre results from cell fusion.**



Place of occurrence :- Striped muscles are found in limbs, body wall, tongue, pharynx, face, neck, initial part of oesophagus, etc.

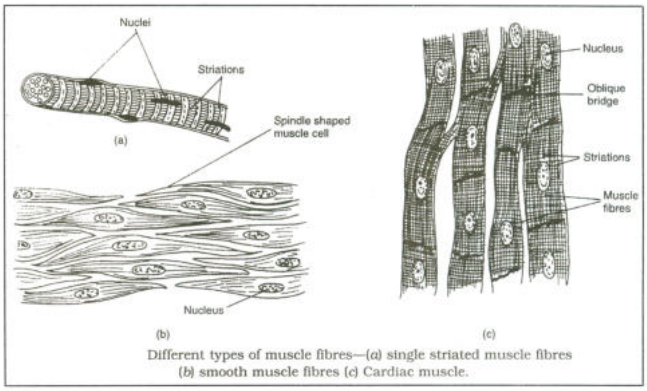
Functions :- Striped muscles produce **rapid and powerful contractions** which help in the movement of limbs and consequently cause locomotion. They are also helpful in the movement of other body parts which are in voluntary control of the individual.

(C) Cardiac muscles :-

Cardiac muscles are the muscles of heart. They are involuntary in action. Cardiac muscles possess characteristics of both striped as well as unstriped muscles, **resembling striped muscles structurally and unstriped muscles functionally.**

Their muscle fibres are uninucleate, branched. The branches of adjacent fibres join to form a network. Each muscle fibre contains a centrally located nucleus. **Sarcoplasm** (Cytoplasm of muscle cell is called Sarcoplasm) bears contractile, longitudinal myofibrils which give the cardiac muscles a striated appearance in the form of dark cross bands called **intercalated disc**.

Place of occurrence :- Wall of heart **(Myocardium)**.



Different types of muscle fibres—(*a*) single striated muscle fibres (*b*) smooth muscle fibres (*c*) Cardiac muscle.

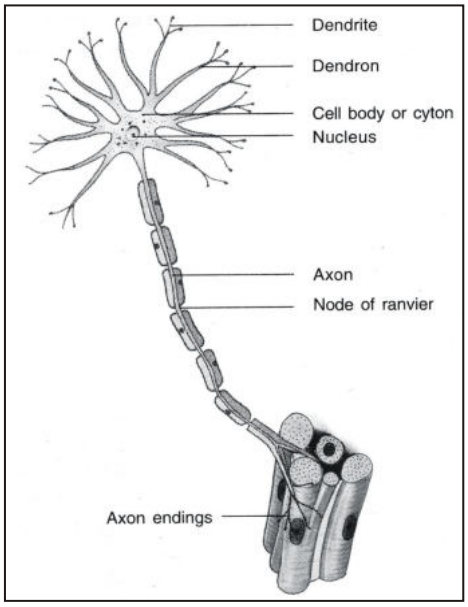
Characters	Skeletal or Striated	Smooth or Non-striated	Cardiac
(i) **Striations**	Present	Absent	Present
(ii) **Shape of the cells**	Cylindrical	Spindle shaped	Cylindrical
(iii) **Branches**	Not branched	Not branched	Branched
(iv) **Number of nucleus**	Many	Single	Single
(v) **Position of Nucleus**	Peripheral	Peripheral	Central
(vi) **Intercalated discs**	Absent	Absent	Present
(vii) **Mode of contraction**	Voluntary	Involuntary	Involuntary
(viii) **Speed of contraction**	Fast	Slow	Fast
(ix) **Length of fibres**	0.02 mm to 0.5 mm	0.01 to 30 cm [longest muscles]	85 to 100 μm (very short)

NERVOUS TISSUE

The nervous tissue, contains densely packed cells called nerve cells or neurons, is present in the brain, spinal cord and nerves. The neurons are specialised for conduction of nerve impulses. They receive stimuli from within or outside the body and conduct impulses (signals) which travel from one neuron to another neuron.

Each neuron has following 2 parts -

1. **Cyton or cell body** – Contains a central nucleus and cytoplasm with characteristic deeply stained particles called Nissl's granules [i.e. clumps of ribosomes]



2. **Cell Processes**

(A) **Dendrites :-** These may be one to many, generally short and branched cytoplasmic processes. Dendrites are **afferent processes** because they receive impulse from receptor or other neuron and bring it to cyton.

(B) **Axon :-** It is single generally long **efferent process** which conducts impulse away from cyton to other neuron.

Longest cell in body is neuron because axon can be more than one metre long. Axon has uniform thickness but it has terminal thin branches called **telodendria**. Terminal **end buttons** or **synaptic knobs** occur at the end of telodendria.

COMPETITION WINDOW

German neurologist **Franz Nissl (1860-1919)** first described Nissl granules in nerve cell, these are formed of rough ER and Ribosomes.

Synapses are junction between two adjoining neurons.

Nissl granules disappear during fatigue and injury to nerve cell and reappear after rest.

Types of Neuron :- Based on number and nature of process arising from cyton the neurons are of different types :-

(a) **Multipolar neuron :-** It has many dendrites and one axon.

(b) **Bipolar neuron :-** A neuron having one dendron and one axon is called bipolar. They generally occur in sensory layers like olfactory epithelium.

(c) **Unipolar neuron :-** It has single process as axon but dendrite is absent.

(d) **Pseudounipolar neuron :-** Such neuron has single fibre arising from cyton which bifurcates into one dendron and one axon.

(e) **Nonpolar or apolar neuron :-** These neurons have many fibres but they are not distinguished into dendrites and axon. Each fibre can receive impulse towards cyton or can conduct impulse away from cyton.

SOLVED PROBLEMS

Q.1 What is histology ?

Sol. Microscopic study of tissues is known as histology.

Q.2 What are unicellular organisms ?

Sol. The organisms having only one cell are unicellular organisms. e.g. chlamydomonas, amoeba.

Q.3 What is a tissue ?

Sol. A group of cells having similar structure and function is called a tissue.

Q.4 Name different type of plant tissues ?

Sol. (a) Meristematic tissue

(b) Permanent tissue.

Q.5 What are the dividing cells at the tip of root and stem known as ?

Sol. Meristematic cells.

Q.6 Name various elements of xylem.

Sol. The various elements of xylem are

(i) Tracheids,

(ii) Vessels,

(iii) Xylem parenchyma, and

(iv) Xylem sclerenchyma (fibres).

Q.7 What is the difference between xylem and phloem ?

Sol.

Xylem	Phloem
(i) It conducts water and minerals from roots to all parts of the plant.	(i) It conducts organic food synthesised in the leaf, and hormones synthesized at the shoot and root tips to other parts of the plant.
(ii) The elements which help in conduction are tracheids and vessels. Both are non-living and highly thick walled.	(ii) Sieve tube cells are responsible for the movement of material through phloem. They are living cells.
(iii) The material in xylem can move only in one direction.	(iii) The material in phloem can move in both the directions.
(iv)Except for xylem parenchyma, all other cells are non-living.	(iv) Except for phloem fibres, all other cells are living.

Q.8 Name various elements of phloem.

Sol. (i)Sieve tubes,

(ii) Companion cells,

(iii) Phloem parenchyma, and

(iv) Phloem fibres.

Q.9 Where are the meristematic tissues found in the plant body ?

Sol. The meristematic tissue is found at all the growing points of a plant such as tips of roots, stems and branches. It is also present between the bark and the wood of trees and leads to increase in thickness of stem.

Q.10 Name three types of blood cells.

Sol. Red blood corpuscles, white blood corpuscles and blood platelets.

Q.11 What are the functions of the connective tissue ?

Sol. The functions of the connective tissue are:

(i) It performs the function of binding, supporting and packing together different organs of the body.

(ii) They connect different tissues and organs and thus provide necessary support to the body.

Q.12 Give reasons why blood is regarded as a connective tissue ?

Sol. Blood is regarded as a connective tissue because blood circulates in the blood vessels to all parts of the body and hence connects them to each other.

Q.13 Explain why thigh muscles get tired soon but not the muscles of the heart?

Sol. Thigh muscles are striated muscles, they contract quickly but cannot remain contracted for a long time and thus soon get fatigued. Heart muscles are cardiac muscles which are voluntary in structure but involuntary in function. They are immune to fatigue.

Q.14 Why ice is applied to the injured area

Sol. If ice is applied to the injured area then the loss of blood is reduced because blood capillaries constrict. The clotting of blood is delayed because low temperature reduces the enzyme activity.

EXERCISE – I BOARD PROBLEMS

Q.1 Name a plant tissue having dead cells.

Q.2 What type of epithial cells are responsible for absorbing food in intestine ?

Q.3 Which muscles act involuntarily ?

Q.4 Where are fats stored inthe human body

Q.5 What minerals is the bone matrix rich in ?

Q.6 Name the water conducting tissue generally present in gymnosperm.

Q.7 Presence of which chemical in cork cells makes it impervious to water and gases ?

Q.8 Which tissue in plants provides them flexbility?

Q.9 Name the dead element present in phloem.

Q.10 Name the muscular tissue that functions throughout life without fatigue.

Q.11 In desert plants, how does the rate of water loss get reduced ?

Q.12 What is responsible for increase in girth of stem ?

Q.13 Name the living element of xylem.

Q.14 Which animal tissue helps in repair of tissue and fills the space inside the organ

Q.15 Where can contractile proteins be found

Q.16 Which cells of plant tissue are capable of cell division ?

Q.17 Which plant tissue is responsible for transportation of food ?

Q.18 Which plant tissue is concerned with conduction of water and minerals ?

Q.19 What is the function of sclerenchyma ?

Q.20 What is a goblet cell ?

Q.21 Where is squamous epithelium found ?

Q.22 What is the name of bone cells ?

Q.23 Which blood cells deal with immune reaction ?

Q.24 Which cells are responsible for contraction an relaxation movements ?

Q.25 Which cells are responsible for carrying messages ?

Q.26 How are oxygen, food, hormone and waste material transported in the body ?

Q.27 Where is apical meristem present ?

Q.28 What is responsible for increase in girth of the stem or root ?

Q.29 Which meristem is located at the base of the leaves or internodes of tiwgs ?

Q.30 Name the parenchyma which contains chlorophyll.

Q.31 Name the parenchyma which has large air cavities.

Q.32 What is the role of aerenchyma ?

Q.33 Which permanent tissue is responsible for the flexibility in plants ?

Q.34 Which permanent tissue provides tensile strength to plants ?

Q.35 Which permananent tissue makes the plant hard and stiff ?

Q.36 What is lignin ?

Q.37 What is cutin ?

Q.38 Which type of phloem cell is non-living?

Q.39 Which xylem tissue allows vertical movement of water and minerals ?

Q.40 Which is the covering or protective tissue in the animal body ?

EXERCISE – II OLYMPIAD QUESTIONS

Q.1 Tendon connects a:

(A) Ligament with muscle
(B) Bone with muscle
(C) Cartilage with muscle
(D) Bone with bone

Q.2 The process by which bone formed is known as:

(A) Calcification (B) Chondrification
(C) Ossification (D) Decalcification

Q.3 During fatigue muscle contains:

(A) More ATP, less glycogen
(B) Less ATP, more lactic acid
(C) Less ATP, less lactic acid
(D) More ATP, more lactic acid

Q.4 Which of the following acts as antibody to help in body defence?

(A) Prothrombin (B) Immunoglobulin
(C) Globulin (D) Albumin

Q.5 Smooth muscle is found in all the sites except:

(A) Gastrointestinal tract
(B) Fallopian tube
(C) Blood vessel
(D) Eyeball muscle

Q.6 In a neuron, dendrite may be one or many, but axon is generally:

(A) One (B) Two
(C) Three (D) More than one

Q.7 A tissue is made up of:

(A) One type of cells
(B) Two types of cells
(C) One or many types of cells
(D) Many types of cells

Q.8 Which one of the following cellular components of the blood is responsible for the production of antibodies?

(A) Thrombocyte (B) Lymphocyte
(C) Monocyte (D) Erythrocyte

Q.9 Which of the following is present in the alveoli of lungs?

(A) Simple columnar epithelium
(B) Simple cuboidal epithelium
(C) Simple squamous epithelium
(D) Sensory epithelium

Q.10 This one is the characteristic of epithelial tissue:

(A) Tissues are highly vascularized
(B) These cells never produce glands
(C) The cells will have a rapid rate of cell division
(D) Large intercellular spaces are seen between cells

Q.11 Blood plasma is:

(A) Neutral (B) Slightly acidic
(C) Slightly alkaline (D) Strongly acidic

Q.12 Which of the following is a transparent tissue?

(A) Tendon
(B) Hyaline cartilage
(C) Fibrous cartilage
(D) All of these

Q.13 Lacuna of bone contains:

(A) One osteocyte
(B) Two osteocytes
(C) Many osteocytes
(D) Many chondrocytes

Q.14 Major protein of connective tissue is:

(A) Myosin (B) Melanin
(C) Collagen (D) Keratin

Q.15 Light bands of muscle fibre are made of the protein:

(A) Tubulin (B) Myosin
(C) Actin (D) Myoglobin

Q.16 Canaliculi are found associated with:

(A) Cartilage (B) Bone
(C) Muscle (D) Neuron

Q.17 Processes from osteoblasts are found in :

(A) Lamella (B) Canaliculi
(C) Dendrites (D) Haversian canals

Q.18 The bone marrow is composed of :

(A) Muscle fibres and adipose tissue
(B) Areolar tissue and adipose tissue
(C) Adipose tissue and calcified cartilage
(D) Adipose tissue, areolar tissue and blood vessels

Q.19 The longitudinal canals of the bone are called:

(A) Volkmann's canals
(B) Haversian canals
(C) Periosteum
(D) Endosteum

Q.20 Volkmann's canals occur in :-

(A) Cartilage (B) Bone
(C) Internal ear (D) Liver

Q.21 The term tissue was given by :-

(A) Robert Hooke (B) Leeuwenhock
(C) Bichat (D) Meyer

Q.22 Presence of tissues in a multicellular organism ensures :-

(A) Faster development
(B) Division of labour
(C) Higher reproductive potential
(D) Body strength

Q.23 Tissue that is absent in monocots is :-

(A) Aerenchyma (B) Chlorenchyma
(C) Collenchyma (D) Sclerenchyma

Q.24 Grit of Pear is formed of :-

(A) Sclereids (B) Sclerenchyma fibres
(C) Tracheids (D) Companion cells

Q.25 Which one is made of dead cells :-

(A) Sclerenchyma (B) Tracheids
(C) Vessels (D) All the above

Q.26 A pair of kidney-shpaed cells present around stomata are called :-

(A) Guard cells (B) Subsidiary cells
(C) Epidermal cells (D) Trichomes

Q.27 Epiblema bears :-

(A) Cutinised hair (B) Uncutinised hair
(C) Root hair (D) Both B and C

Q.28 Tracheary elements of xylem are :-

(A) Tracheids (B) Vessels
(C) Both A and B (D) Sieve tubes

Q.29 Find out incorrect sentence :-

(A) Parenchymatous tissues have intercellular spaces

(B) Collenchymatous tissues are irregularly thickened at corners

(C) Apical and intercalary meristems are permanent tissues

(D) Meristematic tissues, in its early stage, lack vacuoles

Q.30 Which is not a function of epidermis ?

(A) Protection from adverse condition
(B) Gaseous exchange
(C) Conduction of water
(D) Transpiration

Q.31 Increase in the length of the plant is caused by-

(A) cork cambium (B) vascular cambium
(C) apical meristem (D) permanent tissue

Q.32 Cork cambium is an example of-

(A) lateral meristem (B) primary meristem
(C) apical meristem (D) intercalary meristem

Q.33 A simple permanent tissue devoid of intercellular spaces and lignin is-

(A) parenchyma (B) collenchyma
(C) sclerenchyma (D) all of these

Q.34 Interfascicular cambium is an example of-

(A) primary meristem
(B) secondary meristem
(C) lateral meristem
(D) apical meristem

Q.35 Bases of leaves and internodes have-

(A) lateral meristem
(B) apical meristem
(C) intercalary meristem
(D) none of these

Q.36 Parenchymatous cells which are thickened with cellulose at the corner are called-

(A) collenchyma
(B) sclerenchyma
(C) parenchyma and sclerenchyma
(D) none of these

Q.37 Nucleus is not present in-

(A) companion cell
(B) mature sieve tube
(C) phloem parenchyma
(D) collenchyma

Q.38 Sieve tubes and companion cells occur in-

(A) xylem (B) cambium
(C) meristem (D) phloem

Q.39 Elongated lignified cells with pointed ends belong to-

(A) collenchyma (B) parenchyma
(C) sclerenchyma (D) none of these

Q.40 Tissues secreting latex are-

(A) laticiferous (B) glandular
(C) meristematic (D) permanent

Q.41 Tissue is defined as-

(A) group of similar cells having a common function

(B) different types of cells performing the same functions

(C) different types of cells performing different functions

(D) organised group of cells performing many functions.

Q.42 Which tissue provides mechanical strength to plants ?

(A) Sclerenchyma (B) Parenchyma
(C) Collenchyma (D) Chlorenchyma

Q.43 Name the tissue where the cells are living, thin walled, isodiametric with intercellular spaces.

(A) Collenchyma (B) Parenchyma
(C) Aerenchyma (D) Sclerenchyma

Q.44 In sclerenchyma, the cell wall is-

(A) lignified (B) suberised
(C) pectinised (D) cutinised

Q.45 Which of the following cells are dead ?

(A) Parenchyma (B) Collenchyma
(C) Sclerenchyma (D) All of these

Q.46 Which of these types of cells is most likely to divide ?

(A) Epidermis (B) Parenchyma
(C) Meristem (D) Xylem

Q.47 Companion cells are associated with-

(A) Sieve tubes (B) Sclerenchyma
(C) Vessels (D) Parenchyma

Q.48 The tissue that takes part in the transport of food materials is-

(A) Parenchyma (B) Phloem
(C) Xylem (D) None of these

Q.49 Xylem takes part in-

(A) Conduction of water in the plant body.
(B) Conduction of food material

(C) Providing mechanical support
(D) Both (A) and (B).

Q.50 Which of the following are characterisitics of angiosperms ?

(A) Xylem (B) Vessels
(C) Sieve tubes (D) Cambium

Answers

1.	B	**2.**	C	**3.**	B	**4.**	B
5.	D	**6.**	A	**7.**	C	**8.**	B
9.	C	**10.**	C	**11.**	C	**12.**	B
13.	A	**14.**	C	**15.**	C	**16.**	B
17.	B	**18.**	D	**19.**	B	**20.**	B
21.	C	**22.**	B	**23.**	C	**24.**	A
25.	D	**26.**	A	**27.**	D	**28.**	C
29.	C	**30.**	C	**31.**	C	**32.**	A
33.	B	**34.**	B	**35.**	C	**36.**	A
37.	B	**38.**	D	**39.**	C	**40.**	A
41.	A	**42.**	A	**43.**	B	**44.**	A
45.	C	**46.**	C	**47.**	A	**48.**	B
49.	A	**50.**	B				

EXERCISE – III NTSE QUESTIONS

1. Lenticels in a plant are :-

(A) Bud in the axil of leaf

(B) A resinous pocket

(C) A group of loose cells formed in the bark for aeration

(D) A kind of vascular cells

2. Stomata in floating plants are present on :-

(A) Both surfaces of leaves
(B) Lower surface of leaf

(C) Upper surface of leaf
(D) None

3. Branching in root is endogenous because lateral branches arise from :-

(A) Endodermis (B) Epidermis
(C) Cortex (D) Pericycle

4. Lenticels help in :-

(A) Photosynthesis (B) Gaseous exchange
(C) Mineral absorption (D) Food storage

5. Enucleate thin-walled cells with perforated septa are :-

(A) Prosenchyma

(B) Sieve cells

(C) Sieve tube elements
(D) Collenchyma

6. Vascular bundle having xylem and phloem on the same radius is :-

(A) Concentric (B) Radial
(C) Open (D) Collateral

7. The growth in plants is :-

(A) Cuased by each and every cell of the body
(B) Limited to certain regions

(C) Caused by non-dividing regions
(D) Uniform

8. Aerenchyma occurs in :-

(A) Mesophytes (B) Xerophytes
(C) Hydrophytes (D) Sciophytes

9. Angiosperms contain :-

(A) Sieve tubes (B) Vessels
(C) Companion cells (D) All of the above

10. One of the following tissue is responsible for cell division in plants :-

(A) Meristematic tissue
(B) Xylem

(C) Phloem

(D) Sclerenchyma

11. Which group possesses vessels in its xylem :-

(A) Pteridophytes (B) Angiosperms
(C) Gymnosperms (D) Both B and C

12. Collenchyma occurs in the stem and petioles of

(A) Xerophytes (B) Monocots
(C) Dicot herbs (D) Hydrophytes

13. Which is correct about transport or conduction of substances :-

(A) Organic food moves upwardly through xylem

(B) Organic food moves up through phloem
(C) Inorganic food moves upwardly and downwardly through xylem
(D) Organic food moves upwardly and downwardly through phloem

14. A bicollateral vascular bundle is characterised by :-

(A) Phloem being sandwitched between xylem
(B) transverse splitting of vascular bundle
(C) Longitudinal splitting of vascular bundle
(D) Xylem being sandwitched between phloem

15. Sieve tube differs from a vessel in :-

(A) Absence of nucleus
(B) Absence of cytoplasm
(C) Absence of lignification
(D) Absence of plasmodesmata

16. Lignin occurs in the cell walls of :-

(A) Phloem
(B) Cork

(C) Woody tissue/Xylem cells
(D) Parenchyma/Epidermal cells

17. Collenchyma occurs in :-

(A) Herbaceous climbers
(B) Woody climbers

(C) Climbing stems (D) Water plants

18. Aerenchyma assists the plants in :-

(A) Attachment (B) Mechanical strength
(C) Floating on water (D) Exchange of gases

19. When parenchyma contains chlorophyll and performs photosynthesis, it is called :-

(A) Chlorenchyma (B) Collenchyma
(C) Prosenchyma (D) Aerenchyma

20. Which one is not a plant fibre :-

(A) Coir (B) Flax
(C) Hemp (D) Silk

21. The only plant cells without nucleus among the following is :-

(A) cambium cells (B) root hair
(C) companion cells (D) xylem vessels

22. Trachea, tracheids, wood fibres, and parenchymatous tissues are found in :-

(A) xylem (B) cambium
(C) cortex (D) phloem

23. Collenchyma differs from parenchyma in having

(A) cellulose walls
(B) vacuoles

(C) pectin deposits at corners
(D) living protoplasm

24. A tissue whose living cells form the mechanical tissue of activity growing organs and whose cell walls show cellulosic unlignified thickenings often at the corners of its cells is called :-

(A) sclerenchyma (B) collenchyma
(C) Chlorenchyma (D) parenchyma

25. Sieve tubes are better suited for translocation because these :-

(A) are broader than long
(B) possess bordered pits

(C) possess no end walls
(D) possess a broader lumen and perforated cross walls

26. Nerve is

(A) A group of fibres bound by a membrane

(B) A group of fibres bound together by loose connective tissue

(C) A group of neurons only

(D) None of these

27. Mammary glands are

(A) Apocrine (B) Holocrine
(C) Merocrine (D) Endocrine

28. Major protein of connective tissue is

(A) Myosin (B) Melanin
(C) Collagen (D) Keratin

29. Light bands of muscle fibre are made of the protein

(A) Tubulin (B) Myosin
(C) Actin (D) Myoglobin

30. Leucocytes are known as true cells because

(A) They are phagocytic
(B) They do not possess nucleus

(C) They have power of movement
(D) They possess nucleus

31. Erythrocytes and granulocytes normally develop in

(A) Cartilage (B) Red bone marrow
(C) Liver (D) Kidney

32. Areolar tissue joins

(A) Bone with bones (B) Fat body with muscles (C) Bone with muscles
(D) Integument with muscles

33. Coelom is derived from

(A) Endoderm (B) Mesoderm
(C) Ectoderm (D) Dorsal lip

34. Which of the following is found in the blood plasma ?

(A) Fibrin (B) Platelets
(C) Albumin (D) Red blood cells

35. Antibody is

(A) To induce the formation of antigen
(B) To help in the production of WBCs

(C) Formed by some WBCs
(D) None of these

36. The most abundant kind of cartilage in the body is

(A) Elastic cartilage (B) Fibrocartilage
(C) Hyaline cartilage (D) None of these

37. Which of the following part is absent in nerve cell :

(A) Cyton (B) Dendrites
(C) Myofibrils (D) Aron

38. Erythrocytes may have abnormal shapes and sizes in certain diseases In iron deficiency the anaemia will be

(A) Macrocytic (B) Microcytic
(C) Pernicious (D) Megaloblastic

39. The vitamin necessary for normal growth and maintenance of the bone is

(A) A (B) B-complex
(C) E (D) D

40. Cells of germinal epithelium are

(A) Ciliated (B) Columnar
(C) Squamous (D) Cuboidal

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	C	D	B	C	D	B	C	D	A	B	C	D	D	C
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	C	C	C	A	D	D	A	C	B	D	B	A	C	C	D
Que.	31	32	33	34	35	36	37	38	39	40					
Ans.	B	D	B	C	C	C	C	B	D	D					